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# COMPUTER SHOPPER

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**9**  
**TESTED**

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Zardon, KitGuru.net

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# Welcome!



## IT'S THE ETERNAL

computer-buying compromise. Do you have the power, large screen resolution and gaming ability of a desktop PC, and have to find permanent desk space

for a big whirring box, or do you sacrifice oomph and pixels for something you can put away in a drawer?

Or maybe you don't have to choose. This month we show that you don't need to accept less power and an inferior specification to get the convenience of a laptop. Best of all, you don't even have to pay through the nose for the privilege. In our group test on page 78 we show you how to get a laptop that will power through any task for as little as £599.

In computing terms, there are few things as frustrating as not having enough storage. Needing to worry about which programs or games to install, or shuffling photos and videos on to external storage, is a hassle we could all do without.

Such tedium can be eliminated with a simple storage upgrade. This month we've tested hard disks up to 4TB in capacity, which should be enough storage for almost anyone. We've also tested all the latest

solid-state drives (SSDs) which, thanks to their extremely fast file transfer speeds, will make your PC boot faster and feel much more responsive. Find your perfect drive on page 94.

In our features this month we concentrate on two giants of the tech industry: Facebook and Amazon. Facebook is immensely popular, but has a number of features that drive its users up the wall, as well as putting their privacy and personal data at risk. On page 106, we show you how to tame Facebook to make it work the way you want.

Millions of us use Amazon, seduced by its low prices and excellent customer service. But is there a dark side lurking behind Jeff Bezos' all-conquering company? This month we've dug deep into the firm's practices to find out whether Amazon is to be loved or feared. Before you click that 'Buy' button, check out our feature on page 114.

Finally, you may never have wondered what hafnium, tantalum and indium have in common, but without them your PC probably wouldn't exist. Starting on page 122, we examine the elements that make up your PC, and reveal how computing is built on far more than just sand.

**Chris Fennamore, Editor**

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## QUESTION OF THE MONTH

What applications do you want to see for Microsoft's HoloLens augmented reality system?

MEET THE TEAM



**Chris Fennamore**

“Auto-generated training ninjas so I can pretend I'm in a James Bond film”



**David Ludlow**

“I'd like my reality to be augmented by removing all traces of Martin Freeman from it”



**Katharine Byrne**

“Sonic the Hedgehog-style rings along my commute so I can leap through them for points”



**Michael Passingham**

“Augmented-reality fish to make the world into a giant, soothing aquarium”



**Seth Barton**

“Holotoys for the kids, so I can simply switch them off at the end of the day”



**Tom Morgan**

“Automatic household clutter deletion for that minimalist look”



**Richard Easton**

“Augmented-reality bootcamp so I can get yelled at by a sociopathic ex-squaddie at any time, not just 5 in the morning”

## SUBSCRIBE AND SAVE



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OR SEE PAGE 128**



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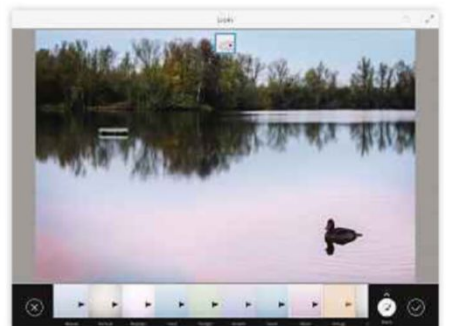
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Transfer files and data from your iPhone, iPad or iPod to your PC with the powerful Leawo iTransfer, free to Computer Shopper readers.




# Letters

You may find it a struggle to watch YouView over a broadband connection – especially if the network is held together by chewing gum and string – but at least watching US TV isn't just Pi in the sky

## CONTACT LETTERS

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London W1T 4JD

### PAINFUL UPGRADE

 I read with interest your comments about the fast and stable Windows 8. My PC downloaded the November update and after rebooting a few times returned a screen saying that Windows needed repairing.

I had everything backed up both on an external hard drive and a NAS drive. Using the USB rescue drive I tried for hours to recover my PC. Reverting to a previous date failed. The rescue disc could not find any restore points or even a disc image.

I resorted to a refresh of my PC. This installed Windows 8 and I tried to update to 8.1. It asked me to install the previous

updates first. There were 118 updates and of course these failed. I resorted to installing them in groups of 5. Eventually I was able to install Windows 8.1. Reinstalling Office 2013 took 35 minutes on the phone writing down lists of numbers from Microsoft. They were not happy because I had installed it before.

Kaspersky wanted me to purchase its software again because I had not purchased its extended download software. Installing all the other programs was also interesting. Neither man nor God could design the update system Microsoft have put in place.


*Robert Montgomery*

That sounds like a horrid experience. All those at *Shopper* have been lucky in our Windows

8 and 8.1 updates, but in the past have been confronted with the horror of failed Windows updates and rollbacks, and having to do everything manually.

When it comes to reinstalling legitimately purchased software, we realise that developers need to protect their hard work from piracy, but it's not too much of an ask to allow you to install software on the same machine again after restoring the operating system without having to ring up and beg.

### GIVETH AND TAKETH AWAY

 I read your article on the availability of fibre (*Shopper 324*) with great interest. I live in a small ex-mining village midway between Sheffield and

Rotherham, and am about as far as I can be from my exchange and still get a broadband connection. By the time the signal has fought its way through the chewing gum and string of the BT network, I get about 0.5Mbit/s – on a good day.

That is, until some three years ago and the arrival of the Digital Region initiative for South Yorkshire. I signed up straight away, and yippee, got an FTTC connection delivered by the BT line to my home and enjoyed the privilege of speed at last! At least I did until August 2014, when the plug was pulled on the Digital Region network, apparently because it hadn't achieved sufficient subscribers to make the network viable.

This wasn't really much of a surprise to me because, as far as

## WIN! Devolo dLAN 650+ Powerline networking kit

Computer Shopper and Devolo have teamed up to offer five lucky readers the chance to win a dLAN 650+ Powerline networking kit, worth £80.

The dLAN 650+ Starter Kit contains all you need to set up a Powerline network around your house, using your electrical wiring to create a super-fast network to give you the ultimate connected home. Just plug one adaptor into your router and a mains socket, then plug the other into another socket wherever you need a network connection. With the dLAN 650+ you don't need to run Ethernet cables around your home to plug your router into a PC, smart TV or games console, and you don't have to rely on a weak wireless signal.

For more information on Devolo and its products, visit [www.devolo.com/uk](http://www.devolo.com/uk). To win, just answer the question below, and email your answer to [letters@computershopper.co.uk](mailto:letters@computershopper.co.uk) with 'Devolo competition 326' in the subject line.



**Q** What is the top speed offered by the Devolo dLAN 650+?

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I could tell, the marketing of the system was done purely via word of mouth. So it's now back to 0.5Mbit/s, with no evidence on the ADSL checker of a BT fibre connection ever becoming available. This is particularly galling as the fibre network is there, but BT apparently has no plans to enter into negotiations to buy the network.

So I'm reading your article again and again and trying every wrinkle that I can extract from it to pressurise someone; but with the rather sinking feeling that it won't make any difference!

Glyn Foster

To go from such a slow ADSL connection to fibre, and then to have it snatched away again, seems cruel to us. It may be time to get your MP involved.

### AVAST ME HEARTIES

Thank you for your review of anti-virus products in *Shopper 324*. For about four years I have been using AVG, after it was given top marks by one of your reviews back then. But now that Avast seems to be much better, I decided to switch.

I eventually got it going on two Windows 7 machines, but I was a bit concerned with the download process; on the Avast site the 'Free download' goes to the Download.com website. This is not good. As a company providing security products Avast should know that third-party hosting is just not on. How do they know that someone hasn't hijacked the Download.com copy of their software and made it into a Trojan horse?

I hunted around the Avast site for a bit and found [www.avast.com/en-gb/store](http://www.avast.com/en-gb/store). If you scroll down there's a section titled, "Undecided? Try our free solutions", and in there is a link to [tinyurl.com/avastavfree](http://tinyurl.com/avastavfree), which lets you download the free Avast anti-virus installer.

If the company already hosts it on its own site, then why on earth does it need to get Download.com involved?

Rob Purvis

Download.com is a popular site for software publishers to host free software downloads, as the company helps them with bandwidth costs, in return bundling pieces of advertising software in the installer to make a bit of cash. For this reason, be careful when installing software hosted on third-party sites and make sure you deselect any

additional software present in the installer. As you've seen, look carefully enough and you can almost always find the software somewhere on the developer's own site.

### CATCH-UP LIMITS

I was interested in your article comparing the Freeview, Freesat and YouView services (*Shopper 325*), particularly as I was unclear as to what YouView is **exactly**. Having investigated further I now understand that YouView makes use of over-the-air digital TV services for live TV but falls back to broadband for everything else. The article didn't really explain this, and even the YouView site is a little vague.

A key difference to the services which was not clearly

stated in the article is the expectation of broadband connectivity and data limits. The article made no reference to this, assuming that everyone has adequate broadband speeds and a big enough data allowance.

I regard my new BT Infinity connection as reasonably fast, but speed isn't everything. It regularly drops out, which spoils watching TV using catch-up services. I can't say I would consider it to be as reliable as the over-the-air DTV services.

I also have a data cap, which I suspect I would rapidly exceed if I made heavy use of services such as this that require a broadband connection.

The assumption that broadband works perfectly and is free, as this article implies, is seriously misleading. It would have been nice to see a table of

## ★ Star letter

### PI JINKS

You mentioned in 'How to watch US Netflix on Chromecast and Roku' (*Shopper 323*) that this isn't possible with a BT Home Hub 5. Well, actually it is with a Raspberry Pi Model B and a Wi-Fi dongle.

I used the Adafruit tutorial to set up a Raspberry Pi as a Wi-Fi access point ([tinyurl.com/piaccesspoint](http://tinyurl.com/piaccesspoint)) using a Wi-Fi dongle I had previously bought on eBay for about £7, knowing it was compatible with the Pi.

I added your iptables commands after the ones in the article, and set the IP address of the Pi's Ethernet connection static at 192.168.1.200. I adjusted the Home Hub's DHCP range to finish at 192.168.1.199. I then placed the 192.168.1.200 address into the Home Hub's DMZ. I then selected the Pi access point on my Roku and managed to register it as located in the US.

That was all I needed to do to get my Roku streaming US Netflix – and all for about £7 (plus the Pi which I had lying around) and removing the need to replace the Home Hub with a DD-WRT-capable router. This solution is quite neat, as it means if I want to appear as located in the US, I select one access point, and can quickly revert to being a UK resident by switching back to the Home Hub.

Julian Ariel

We are suitably impressed with your elegant solution. Thank you.



Watching US Netflix broadcasts is simple with a Raspberry Pi Model B and a cheap Wi-Fi dongle

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data usage given different mixes of live and catch-up TV usage.

Nick Hoare

We should have made it more clear that all catch-up services rely on a broadband connection – otherwise TV channels would have to rebroadcast programmes at the whim of individuals, which would be physically and logistically impossible. If you don't have a good broadband connection, make sure you buy a decent PVR, plan ahead and set all the programmes you want to watch to record.

### FALSE ECONOMIES

Although I agree with much of Chris Finnermore's Rant in *Shopper* 325, especially regarding expensive cables, I'd like to warn readers to be careful when considering cheap USB power supplies. There are many stories on Amazon reviews and other parts of the web of these cheap power supplies at best not working and at worst destroying the equipment they're charging and even exploding, shorting the mains or catching fire.

To save a tenner and then burn the house down doesn't seem a reasonable investment to me. There doesn't appear to be any national standard or kite marks for these chargers, even though they plug into a normal 240-volt electricity supply.

David Lea

We agree that some USB chargers may indeed be dodgy, which is why we tend to avoid buying models off eBay and use reputable companies such as [cpc.farnell.com](http://cpc.farnell.com) instead.

### LIGHTING THE SPARK

David Robinson outlines what he feels is a misguided and unnecessary change to IT in schools (*Under Development*, *Shopper* 325). Adding 'Computational thinking', including some coding, alongside IT and digital literacy into the new subject of computing is, in my opinion, a change that should have been made years ago.

Education is about opportunity, and too often in the past it hasn't acted in this way. Unless children encounter a wide range of experiences, they may never find that one thing in life that's right for them. Subjects such as computing should hit as many IT-related opportunities as possible, including developing skills in using existing software (which is still part of the National Curriculum), solving problems algorithmically, understanding how to write code, and how to stay safe online. One teacher who taught me in 1982, and had a passion for the new 8-bit computers hitting the market at that time, lit the spark that pushed me on to the career in mathematics and computing that I now have.

Whether making a pencil case in DT inspires a student to become a carpenter, or just provides the early warning that they'll be lousy at DIY when they're older, doesn't make it a poor thing to try. Not every pupil becomes a mathematician or accountant, but they all need to be numerate. Not every student taking history will become a historian. Likewise, in the 21st century, all students should have the chance to try coding, and thus appreciate the hard work David and his colleagues put into writing software they may otherwise take for granted.

This move was not imposed by the government. It was a response to a profession-led movement of which I was a part. We don't want a nation of coders; we want to give all the opportunity to encourage more students in the direction of science, technology, engineering and mathematics careers.

Matt Gowen

Head of Computing & E-Learning  
The Norton Knatchbull School  
Ashford, Kent

Just as not everyone who takes French will grow up to be an EU translator, not everyone who takes coding lessons will be a Zuckerberg, but that doesn't make it a waste of time. In the process of turning children into well-rounded adults, there's plenty of room for learning for its own sake. ☐

## WRITE IN AND WIN

Do you wish your computer was faster when booting and loading applications? Thanks to Crucial, you can achieve your dream of a faster PC or laptop with the MX100 SSD. The writer of our Star Letter will be awarded one of these solid-state devices, which can be installed in a desktop PC or a laptop.

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## NEXT MONTH

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We show you how to get the most out of the latest version of the world's most popular smartphone operating system



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### › FREE LIGHTROOM RIVALS

We check out the free alternatives to Adobe's excellent Lightroom photo management and Raw processing software

### › HOW HACKERS HACK

Not a day goes by without some new high-profile hack, but how do cybercriminals really break into systems? We find out



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# Hard rein

When his internet connection drops yet again, **David Robinson** is surprised to discover that it's all down to the amount of rein we've been getting



**DAVID ROBINSON**  
Software and systems developer  
davidr@computershopper.co.uk

**READERS MAY REMEMBER** the palaver I've had on previous occasions (see *Shopper* 315) with our home broadband ADSL line. It works fine for several months at a time without a problem, but then we experience periods when the line drops then reconnects itself. Or sometimes doesn't.

I've spent hours on the phone to my ISP and been given all manner of dubious advice. The first time it happened the support engineer confessed on the fourth call that the ISP had been fooling with the settings to make things 'better', and one of the changes had rendered our Zyxel router unsuitable for the ADSL Plus service we were (not) getting. In response, I bought a new router – a TP-Link model – which, for a while, worked.

## ROUTER ALL EVIL

When the problem returned, the support guy suggested I had a faulty router and that I should try another. "How about a Zyxel?" I asked. We tried it, and it worked. When we swapped back to the TP-Link that one worked too, and the service was once more fine for several weeks. Then the line-drop problem returned again,

new ADSL microfilter – the little white box that splits the single incoming phone line into two, for voice calls and the internet.

I was dubious, but you have to play along or they mark you down as uncooperative and you get no help at all. Given the progress we'd made, it was unlikely this could have made the situation much worse. One trip to PC World later with my wallet lighter by a fiver and, you guessed it, the problem was still there. It then went away for a day, then came back again.

The support desk suggested sending an engineer with some diagnostic equipment to test the line. The test engineer failed to turn up for the appointment, so I made another one. Eventually his equipment decided there was nothing wrong with the line. The ISP sent me a bill for £100 for the "diagnostic service". I told them where to put it – and, while it may have been painful, they did.

Anyway, the problem disappeared, all by itself, for another five months. Then it came back again, sometimes with a vengeance. Doing out-of-hours support for custards from home was severely impaired.

## DON'T STOP THE MUZAK

Trying the usual remedies failed to improve the situation. The two good routers and microfilters proved that the problem wasn't equipment failure at our end. There was nothing for it but to endure more muzak waiting for yet another support engineer to become available.

We went through the usual question and answer sessions. "What's your postcode?" asked Andy (by this time we were on first-name terms). Telling him this gleaned the baffling reply, "Ah, you're in a known rain area".

"Look," I said, "I know it's chucking it down outside but are you telling me that every time it rains the internet goes screwy?"

"Nope," said Andy. "R-E-I-N

stands for Repetitive Electrical Impulse Noise. Your area suffers from a lot of it."

"So all my neighbours have the same problem?"

"Yup."

"And how long have you guys known about this?"

"Oh, ages," said Andy, "it's in our support database."

Well, thanks. I don't suppose the ISP wants to buy a used router and microfilter?

"What's the cause?" I said.

"Dunno."

"What's the cure?"

"Dunno."

"Can we do anything to fix it?"

"Well, your contract provides for 12Mbit/s. I can reduce the speed to four if you like."

To be honest I didn't like the sound of that, but the alternative was being left at the whims of random outbreaks of REIN so I agreed to try a period with the service reduced to a minimal speed, monitoring the quality and getting Andy to increase it if the reliability suggested we might eke out a bit more bandwidth.

And it's worked. We still get the occasional dropout but the prolonged agonising spells where the connection won't stay alive have disappeared. As we don't download films the browsing experience isn't too bad.

## COME REIN OR SHINE

The causes of REIN are many and varied. Typical of the IT industry, which loves acronyms, there's also a related problem called SHINE (Single Isolated Impulse Noise). The guy who made that up was either desperate or a poor speller. For a full explanation of both phenomena, see [tinyurl.com/reinorshine](http://tinyurl.com/reinorshine).

After the speed change Mrs R commented on the improved reliability (she gets cross if her Kindle and Nexus 7 won't work) and asked me what was causing the connection problems. She looked quite perplexed when I told her, "It's the rein, dear". ☐

"What's your postcode?" asked the support engineer. Telling him gleaned the baffling reply, "Ah, you're in a known rain area"

only worse; neither router could be persuaded to connect to the net. The ADSL light was on, so confirming a physical connection to the exchange, but the internet light remained unlit, indicating that the router hadn't succeeded in logging in.

Interrogating the router status via the browser confirmed it hadn't picked up an external IP address from the ISP's DHCP server. Yet another engineer on the support desk suggested a







# Thoroughly modern warfare

The cyberbattle between the US and North Korea represents a dangerous and unpredictable new development in global conflict, says **Gordon Holmes**



## GORDON HOLMES

With more than 30 years of experience in law enforcement, our retired cop gives a police officer's perspective on the sticky subject of cybercrime  
letters@computershopper.co.uk

**FOR A COLUMNIST** writing for a monthly magazine, commenting on a current news story is a risky business. The time between writing and publication can be a few weeks, so there's a distinct possibility of offering opinions that are revealed by later events to be complete rubbish.

However, the Sony hack has thrust the subjects of cybercrime and cyberwarfare so firmly into the public spotlight that not commenting would be worse than any potential egg on face.

As soon as details of email exchanges between Hollywood executives and those egotists employed in the name of entertainment were published, the stage was set (if you'll pardon the pun) for some pretty heavy finger-pointing.

The FBI became involved, and North Korea was identified as being responsible for the hack, as a reaction to *The Interview*, a film lampooning North Korean leader Kim Jong-un. The evidence on which the FBI based its accusation has never been made public nor, in my opinion, should it be.

## PEN AND INK

In late November, Sony employees in Los Angeles logged on to their

100 terabytes of data had been stolen from Sony's servers.

So far, so depressingly familiar. The juvenile pictures showing a scary skeleton and luminescent spider are typical of the adolescent mindset we see time and time again as activists deface websites and gain control over systems. Is this really the signature of a nation state exacting revenge over a film?

In fact, the film in question was never mentioned in the context of this cyber-attack until some days after the breach, when North Korea denied all involvement but praised the actions of the hackers, describing the attack as a "righteous deed".

## IDENTITY PARADE

The debate among internet security luminaries cast some doubt on this theory. After all, this hack and the subsequent leak follow a familiar pattern, and as we've discussed previously, the clues to identifying cybercriminals lie not only in the signatures of malware coding, but also in the modus operandi and associated forum chatter.

This doubt means theories as to who is responsible continue to circulate, with speculation that it was a disgruntled employee or Russian political group using a readily available piece of malware. In the meantime, the FBI has maintained a resolute silence since its initial statement.

This attack was a criminal offence, and law-enforcement agencies should conduct a robust investigation. The FBI has the resources and expertise to get to the bottom of this incident, and should be left to get on with it. What is of more concern is the escalation of this crime into what appears to be full-on cyberwarfare.

It's been reported that North Korea has suffered at least three total internet outages in a seven-day period, and that these outages followed a statement by

Barack Obama that the US would retaliate for the Sony hack at a time and date of its choosing. The US denies the interruption of internet services to North Korea is as a result of US intervention, but the timings of the outage may be more than coincidence.

## THREAT TO HUMANITY

This series of events occurred at about the same time as a report from a group of Cambridge researchers appeared, stating that the internet is one of the greatest threats humanity faces. The Centre for the Study of Existential Risk (CSER), co-founded by Professors Huw Price and Martin Rees, has a mission to study threats posed by technological advances, artificial intelligence, nanotechnology and climate change (see [cser.org/emerging-risks-from-technology](http://cser.org/emerging-risks-from-technology)). One of the centre's research strands is the fragility of the extensive connectedness on which we all rely.

Cyberattacks are becoming increasingly destructive, and the associated remediation costs are having a significant impact on affected business. This cost has the potential to affect global economies, which is why we've seen nation states getting involved in what are criminal offences. Capitalism is arguably one of our finest achievements but it is also one of our weakest links, and the combination of cybercrime and tit-for-tat retaliation is a dangerous game with an unpredictable outcome.

The outages in North Korea affected both its telephony and nascent internet network. I hope a lid is kept on this and that we don't see retaliatory cyberattacks on the West's more connected and internet-dependent national infrastructure.

That way I won't have to reach for the napkin to wipe the yellow eggy stuff from my face – if I can even find my napkin in the dark. ☒

Cybercrime has the potential to affect global economies, which is why nation states are getting involved in criminal offences

terminals to be greeted by a grinning skeletal figure and a demand for Sony to obey commands issued by the hackers. Computer and telephone systems were frozen, and employees were forced to work using pens and paper (I know, scary stuff).

The hackers' message purported to be from '#GOP', which stands for Guardians of Peace, and contained hyperlinks pointing to evidence that some



\*Case for illustration only

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# RANTS & RAVES

Some things in life, such as the humble manual, are much lamented. Others, such as the often indecipherable squiggles of CAPTCHA, are less so



*Michael Passingham*

## RANTS

RTFM? Chance would be a fine thing, especially if you're struggling to use your new smartphone for the first time

**MANY CHILDREN OF** the 70s, 80s and 90s will fondly recall the days when every game you bought came with a 50-page instruction manual detailing every element of the backstory, controls and onscreen display. Some even came with blank pages for you to write notes.

All this made for great reading on the way home from the game shop, but I have to admit that nowadays such printed manuals are a waste of space, which is why most current games simply come with a slim pamphlet telling you to visit the website for more information.

As far as games are concerned, this makes sense. The first 20 minutes are usually an extended tutorial anyway. Where the lack of a manual doesn't make so much sense is with modern consumer technology. It's more complex than ever, in case you hadn't noticed, and it's a bit much to expect people to work out iOS, Android or Windows Phone from scratch when even a Nokia 3210 came with a decent manual back in 1999.

Tech firms seem to skew all their efforts towards the younger markets but completely fail the older generations who didn't grow up in a world dominated by swiping on touchscreens and sliding through Facebook.

This problem was starkly illustrated at Christmas when I gave my 63-year-old mother an Android-powered Samsung smartphone. What little paper there was in the box gave almost no information about how to use the phone. This put her off owning a smartphone, and it was only because I was *chez* parents for a week that I was able to guide her through those terrifying first few days as she got to grips with a pocket computer from scratch.

My mum wasn't even trying to do anything advanced. In order to answer incoming calls on Android phones, you have to place your thumb within the green telephone symbol and slide it out towards the edge of the screen until the phone is answered. Of course, the first time my dear sweet mother received a call on her device

was when she was out and about, without me there to explain to her what was going on. An onscreen animation perhaps suggests you have to slide your thumb, but to someone not familiar with sliding gestures, this means nothing. There were plenty of missed calls that day, which a simple green answer button would probably have avoided.

There are even companies that specialise in producing third-party gadget manuals; O'Reilly's *Missing Manuals* range is probably the most famous, but this is the kind of information manufacturers should be providing in the first place.

Anti-virus firm AVG recently published a study that found 54 per cent of people over 50 in the UK felt tech companies spent too much time assuming they were technology-illiterate, with 48 per cent of the group feeling "they get talked down to". I'd rather get talked down to than have no idea how to use my phone for weeks on end, though. For the sake of my mother and everyone like *her*, give us the manuals we deserve.



Mel Croucher

## RAVES

Proving you're not a robot just got a whole lot easier, as long as you can spot a turkey when you see one. Alan Turing would be proud

**THE GREAT ALAN** Turing invented modern computing, defeated Adolf Hitler, pioneered artificial intelligence and boosted the career of Benedict Cumberbatch. In 1950, the computer genius devised the Turing Test, to measure how far a machine can fool people into believing it is as human as they are. Unfortunately, half a century later, a bunch of American boffins came up with the Completely Automated Public Turing-test to tell Computers and Humans Apart, known as CAPTCHA. And that was when the misery began. For the past 15 years, I have suffered along with the rest of humanity from innumerable online pages demanding to know if we are human. This involves deciphering a string of characters with revolting shapes, colours and backgrounds, then failing to type them into a little box.

The CAPTCHA is supposed to sort the fleshly sheep from the electronic goats, and weed out automated swindlers, spammers

and slimeballs, but all it really does is slow everything down and add to the sum of human misery. More so if the hapless human is hamfisted, sight-impaired, colourblind, dyslexic or daft. What's more, the randomly generated distorted text is useless in keeping the robots out. There are now software bundles that can crack the most complex CAPTCHA strings with 99.8 per cent accuracy, which is much better than most human brains can achieve, and infinitely better than my own ability.

So it is with delight that while blundering around some WordPress sites, I discover my misery is over. And it's all thanks to Google. WordPress is one of a growing number of major outfits to sling out the outmoded text-based CAPTCHA gatekeepers in favour of a ludicrously simple idea from the mighty Google, which relies on emotional reactions. I am presented with a simple invitation to pick my favourite colour and then tick a

little box that says "I am not a robot." My favourite colour is 'freckles by candlelight', and that isn't in the options, but I persevere. As an alternative, I am then shown a picture of a pussy cat and invited to click on matching images that also feature dogs, guinea pigs and what look suspiciously like marijuana leaves. Easy! Even I can click on a cute little kitten in a box, whereas a malware script would not even recognise the question let alone the answer.

This new test is called reCAPTCHA, and I have just come across it again on Humble Bundle, the bargain-rail gaming website. This time I am asked to match up images of turkeys, and I confess to experiencing a few seconds of mindless pleasure as I click on the gobbling fowls and avoid bowls of cranberry sauce. An automated gatekeeper with a sense of humour. How splendid. Beating the bad robots is no longer a chore, it has just become a pleasure. GOTCHA!



Richard Easton

## RANTS

Companies are constantly trying to tempt new customers with enticing special offers, but what price loyalty for the rest of us?

**AS AN AVID gym-goer**, I view January with a mixture of fear, uncertainty and doubt. In the world of fitness, the first month of the year sees an influx of Lycra-clad new members looking to shed the Christmas weight and kick-start their healthy lifestyles as part of a hopeful new year's resolution.

Although I welcome anyone looking to improve their health, and I'm the first to offer some motivating words and guidance, it's a little disheartening to see the number of bright-eyed, bushy-tailed wannabe-henches diminish as the weeks roll by.

Gyms take advantage of this surge of interest by offering a slew of incentives for new members. This is all very well, but the rest of us loyal members are left in the cold,

devoid of our three free months and complimentary dumbbells, all the while having to push through the throngs of newbies to use any of the equipment. The reason gyms offer up these incentives is obvious: after the initial surge attendance drops off, but a mixture of inertia and pride means a chunk of new members will carry on paying their subscription fees regardless.

This phenomenon is also rife in the world of tech, with special offers dangled in front of potential customers. There are free trial periods for new members of Amazon Prime or Netflix, and reduced rates for three months from Spotify. This is not to mention the special sign-up deals from broadband providers; Plusnet, for example, will let you

have fibre broadband for a ludicrous £3.75 a month for the first six months.

In contrast, rarely do we see any rewards for long-term loyal members. There are exceptions; Microsoft gave out a free copy of Limbo on Xbox One for those who bought the console at launch. It's hardly a new game, though, and early adopters who paid through the nose for the console in the first place are probably left feeling bitter by all the subsequent Xbox One price cuts.

It would be wonderful if customer loyalty were more often rewarded, especially if those rewards didn't only materialise when you're threatening to cancel the service. I suppose I'll have to be content with a free cappuccino after I've bought nine others. ☕



# CES 2015

## THE HIGHLIGHTS

**CES IS THE** biggest technology trade show of the year, giving us our first glimpse of the gadgets that will arrive in stores in 2015. We were on the ground in Las Vegas to see it.

### BROADWELL HAS LANDED

After more than a year of waiting, Intel's 5th Generation Core processor architecture, **Broadwell**, is finally here. First teased at IDF back in 2013, Broadwell is the first Intel Core processor to be manufactured on a 14nm process, offering even better power saving, video conversion and gaming capabilities.

The first wave of chips consists of 14 new dual-core four-thread CPUs with speeds from 1.5GHz to 3.1GHz, and the range will be split between 15W models with Intel HD Graphics and 28W models with Iris Graphics. HD Graphics 5500 and 6000 and Iris Graphics 6100 all represent a jump in GPU performance for Intel chips, gaining support for DirectX 11.2, OpenGL 4.3, OpenCL 2.0 and DirectX 12 when it arrives. The new chips can connect to 4K Ultra HD displays at 3,840x2,160, wired or wirelessly, and have better support for HEVC video decoding, for more efficient 4K decoding.

RealSense technology will use integrated cameras to 'see' in 3D, scanning objects for editing and 3D printing; to separate objects from backgrounds for green-screen effects in videos without having a green screen; and to control objects in 3D space with gestures or facial expressions. We have yet to put these bold claims to the test, but they could be useful tools for designers and 3D graphics professionals, as well as those with disabilities.

The Broadwell line-up will initially focus on laptops, Ultrabooks, 2-in-1 hybrids, low-power all-in-one PCs and premium tablets, so don't

expect any multiplier-unlocked K-series chips like the Haswell Core i5-4670K just yet. Intel expects sub-45W processors to launch for high-powered laptops and desktop PCs in mid-2015, which would make it one of the fastest rollouts for a new Core processor.

### 5K WINDOWS

A slew of new laptops and monitors were announced at CES, the most interesting of which was HP's first 5K monitor. Apple may have launched its 5K Retina iMac a few months ago, but the **HP Z27q** stands out thanks to its much lower price of just \$1,299 (around £865).

The Z27q has a jaw-dropping 5,120x2,880 resolution, but its 10-bit panel gives it excellent image quality credentials too, especially if HP's claimed figure of 99 per cent coverage of the RGB gamut proves to be true. It has only two DisplayPort 1.2 inputs, as other common connectors such as DVI and HDMI can't support the full resolution, but it's compatible with Thunderbolt ports on Macs.

### OLED v LCD

All the major TV manufacturers were out in force at CES, but LG stole the show with its announcement of seven new **OLED TVs**, signalling a major boost for the technology at a time when other manufacturers are turning their attentions towards LCD panels. Among the various flat and curved 4K models, the highlight was LG's 77in flexible display, which bends at a press of a button.

Not to be outdone on the 4K front, Samsung announced a new premium brand of 4K TV called **SUHD**. They're not OLED, sadly, but their nanocrystal semiconductors should produce deeper blacks and better colours than traditional LCD screens. It's essentially the same technology as quantum dot, which is used by rivals Sony and LG in their LCD TVs, but Samsung says its 2015 TVs should have more than twice the brightness of a normal LCD. However, until we've seen one side by side with an OLED TV, we'll have to reserve judgement on which one is best.



### OS BATTLES

Picture quality is an important part of a new TV, but the bigger battle this year is likely to be waged over new Smart TV interfaces, as all the major manufacturers announced significant

overhauls to their current operating systems.


LG will be sticking to its webOS platform, but it's promised its updated **webOS 2.0** will be up to twice as fast as its predecessor. 4K streaming services will also be expanded from Netflix and Amazon Instant Video to include YouTube and Vudu, while GoPro will arrive as an exclusive content partner for 2015.

Samsung, meanwhile, confirmed that all its 2015 Smart TVs will be built around the **Tizen** operating system, the open-source platform Samsung itself had a hand in creating. Although Tizen is still mostly an unknown quantity, there's at least one new feature you should be looking forward to: PlayStation Now game streaming.

Currently limited to North America, PlayStation Now lets you pair a DualShock 4 controller with the TV via Bluetooth and play PlayStation 3 titles over the internet. We're still waiting for the service to launch in the UK, but we've been impressed with the visual quality and low latency when playing in the US.

Meanwhile, Sony's new Bravia TV range will include some of the thinnest LCD TVs ever produced, and feature Smart TV models running Google's **Android TV** operating system for the first time. This includes the stunning **X90C**, which measures just 4.9mm at its thinnest point, making it even slimmer than a smartphone. Throw in several models with Hi-Resolution Audio-compatible speakers and a brand new 4K image processor, and Sony is looking like a strong contender for anyone looking to upgrade their TV in 2015.





Measuring just 4.9mm thick, Sony's X90C will be the world's thinnest LCD TV

TP Vision, the company behind Philips TVs, also pledged to put Google's operating system in its range of smart TVs and UHD TVs. We already saw Android TV running on Philips' 9809 series back in August at the IFA 2014 trade show, but this year Philips' Android TVs will all run Android 5.0 Lollipop, bringing Google's Material Design scheme to the big screen.

Android TV is essentially a big-screen version of the smartphone and tablet OS, with a simple card-based interface that puts a list of recommended titles and recently placed programmes at the top of the screen and your installed apps underneath. YouTube, Google Play Movies and Google Play Music are pre-loaded, and you'll also have access to the Google Play Store for downloading BBC iPlayer, 4oD, Demand 5, Netflix and more.

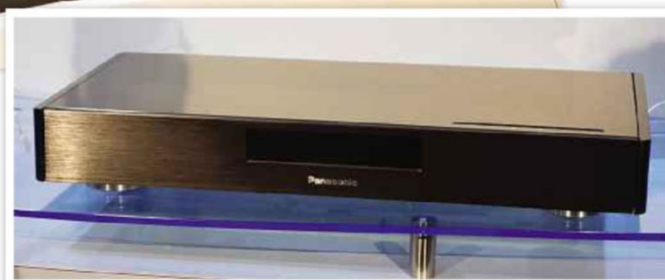
Panasonic also announced that selected 4K models will be adopting Mozilla's latest **Firefox OS**. We saw it in action on the show floor and its incredibly minimal UI is almost entirely made up of colourful, circular icons. The simple pastel shades and large blocks of colour are all very reminiscent of Firefox OS on mobile, as well as Google's Android 5.0 Lollipop Material Design UI.

It's also very similar to LG's webOS interface, although Panasonic will apparently set its interface apart by adding interactive notifications from applications and, further in the future, from connected home appliances. Essentially, your TV could let you know the washing machine has finished, so you can pause the action and hang out your clothes.

#### 4K IN YOUR HOME

4K TVs are all well and good, but even now there's only a pitiful amount of content you can actually watch. 4K streaming is one answer if you have a fast internet connection, but it's difficult to beat the convenience of a Blu-ray disc. Fortunately, Panasonic brought us one step closer to the dream of proper 4K home cinema at CES this year with its prototype **4K Blu-ray player**.

Panasonic revealed the player along with news that it was a member of the newly



↑ With the arrival of Panasonic's prototype 4K Blu-ray player, we could see proper 4K Blu-ray films by the end of the year

founded UHD Alliance, a group of manufacturers, content creators, film studios and distributors looking to advance video standards beyond 1080p resolutions. This is the second big jump for 4K Blu-ray in less than six months, as the Blu-ray Disc Association (BDA) confirmed at IFA in September it had approved a draft specification for the discs themselves.

We were told at the time that everything should be finalised by the summer, with hardware arriving by the end of the year, although names, logos and exact technical details have yet to be finalised.

#### WEARABLE TECHNOLOGY

Circular smartwatches arrived in a big way in 2014, but now Motorola's Moto 360 and LG's G Watch R will be getting some more circular competition this year in the form of the **Alcatel OneTouch Watch**.

Alcatel's OneTouch Watch comes with a built-in optical heart-rate sensor



The screen measures 1.22in, but the outer edge of the watch face is fixed in place. Alcatel wouldn't confirm the screen's resolution or the type of display, but it does have an optical heart-rate sensor on the underside of the watch that measures your pulse, and an integrated accelerometer, gyroscope, altimeter and e-compass to count your steps and daily exercise.

Rather than use the existing Android Wear platform, the OS is one of Alcatel's own design, making it the first smartwatch you can pair with both Android and iOS devices.

However, only Apple's official phone, messaging and mail apps appear to work when paired to an iPhone at the moment, whereas Android users can get messages from any app capable of sending push notifications.

Still, Alcatel has clearly been paying attention to complaints about smartwatch battery lives, as the OneTouch Watch has a rated life of between two to five days. It even has a USB connector built straight into the strap for instant charging, so you can say goodbye

to those cumbersome charging docks.

Withings introduced a cut-down version of its expensive Activité watch, the **Activité Pop**. At first glance, it looks like a traditional analogue watch with a second, smaller dial beneath the hour and minute hands, but once you pair it with a smartphone app over Bluetooth, it can track your daily steps and measure sleeping patterns. Admittedly, it doesn't do much else, but at least you don't need to worry about charging it as it takes a standard watch battery which Withings says will last for eight months.

Finally, the **Sony Smartwatch 3** has had a stylish stainless steel makeover, giving it a much needed upgrade from its current plastic finish. You can now simply pop the watch out and place it in an alternative surround, so you could potentially wear the stainless steel version to work then swap it for the plastic surround when heading to the gym.

Withings' Activité Pop has an analogue watch face, and can transmit exercise data to your smartphone





# New ultra-slim 12in MacBook Air will have only one port

**APPLE IS PLANNING** to launch a 12in version of the MacBook Air that is so slim it only has space to accommodate a single, new type of USB port. The MacBook Air has been through eight different revisions since its launch in 2008, but this rumoured new design may be the most significant yet.

Although nominally bigger than the 11in version of the MacBook Air, the 12in model will actually be narrower than its 'smaller' sibling, according to an Apple insider who provided an unusually detailed description of a prototype device to the 9to5Mac website. That's because Apple has reduced the width of the screen bezel to almost nothing, and has also squeezed the keys on the keyboard closer together. The keyboard now runs from edge to edge, with only a very thin bezel on either side.

Apple has also been forced to redesign the trackpad to fit within the thinner frame. The trackpad will no longer provide a physical click when depressed, a loss that may be mourned by some users.

However, the biggest and most controversial consequence

➔ The new Macbook Air may only have one port, but USB Type-C is a very versatile connector

of the new design is that Apple has only left room for a single port on the edge of the laptop. That port will be the new USB Type-C, which has a smaller connector and allows the cable to be plugged in either way up. The port can be used to drive peripherals or displays, and can also be used to recharge the laptop's battery.

With only a single port, Apple will likely have to supply some kind of docking device, so users can plug in external screens and peripherals while using the laptop at their desks. The only other connector on the prototype MacBook Air is a headphone/microphone socket.

The shift to USB Type-C is something of a surprise, given the effort Apple has put into engineering the Thunderbolt and Lightning connectors. However, neither of those can be used to power the laptop, which may have swayed Apple's decision to move on.

9to5Mac's source claims the revamped design is already nearing production and could be launched by the middle of the year. Some sources are speculating that the new MacBook Air will be significantly cheaper than its predecessors, providing competition for low-end Windows laptops and Chromebooks. We suspect that is little more than wishful thinking.



## Night-time iPad reading 'could disrupt sleep patterns'

**STRUGGLING TO NOD** off after your bedtime story? A new study claims that reading from an iPad or other backlit eReader before bedtime can damage sleep patterns.

The research, conducted by Harvard Medical School, saw 12 people sleep in a laboratory for a fortnight. On some days they were given paper books to read before bed, on others they were given iPads. The research showed that sleep patterns suffered on the days when people were using the iPads, adding further weight to earlier research which has shown the blue light emitted from electronic devices interferes with the production of sleep-inducing hormones.

"The use of light-emitting electronic devices for reading, communication and entertainment has greatly increased recently," the

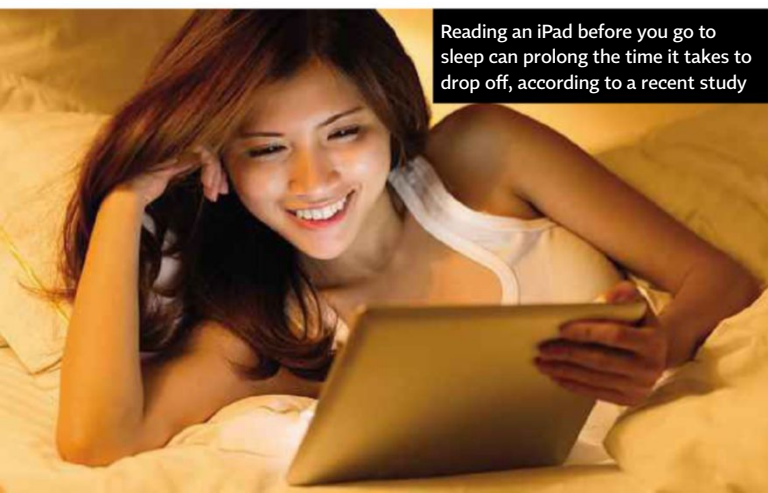
research paper states. "We found that the use of these devices before bedtime prolongs the time it takes to fall asleep, delays the circadian clock, suppresses levels of the sleep-promoting hormone melatonin, reduces the amount and delays the timing of REM sleep, and reduces alertness the following morning.

"Use of light-emitting devices immediately before bedtime also increases alertness at that time, which may lead users to delay bedtime at home," the paper adds. "Overall, we found that the use of portable light-emitting devices immediately before bedtime has biological effects that may perpetuate sleep deficiency and disrupt circadian rhythms, both of which can have adverse impacts on performance, health and safety."

Although the research was conducted using just Apple's tablet, the researchers claim that other tablets and backlit eReaders, such as the latest Kindles, would have a similar effect. Early Kindle models, which didn't use backlighting, would be unlikely to disrupt sleep, scientists say.

The researchers are particularly worried about the damage e-readers may be doing to children's health. "Because technology use in the hours before bedtime is most prevalent in children and adolescents, physiological studies on the impact of such light exposure on both learning and development are needed," the paper states.

"Further investigation of the physiological and medical effects of electronic devices is warranted, because the acute responses to the short-wavelength-enriched light emitted by them may have longer-term health consequences than previously considered."



Reading an iPad before you go to sleep can prolong the time it takes to drop off, according to a recent study

# Amazon Instant Video begins 4K streaming

**AMAZON IS NOW** streaming movies in the Ultra HD resolution in the UK. Amazon switched on 4K streaming in the US in December, but quietly added it in the UK a few weeks later.

The service is currently only available through apps on Sony Ultra HD Smart TVs, with further models from LG and Samsung due to be added this year. However, unlike rival Netflix, Amazon won't charge you extra to receive streams at the higher resolution, at least for the time being.

The company will offer 4K content to both Amazon Prime customers and those making standalone movie purchases. Titles including *Captain Phillips* and *Crouching Tiger, Hidden Dragon* are available in Ultra HD, but will set viewers back £14.99 a pop. Amazon will also be streaming its burgeoning library of in-house productions in 4K.

Video-streaming rival Netflix already offers 4K streaming in the UK, although customers have to upgrade to a top-tier subscription to

receive the Ultra HD streams, costing £8.99 per month instead of the regular £5.99. Such streams also require a fibre/cable broadband service, with Netflix recommending a connection speed of at least 25Mbps/s to stream the 4K content. As with Amazon, Netflix only supports 4K streaming on a limited selection of TV models; you can't access 4K streams via a web browser, devices such as the Apple TV or games consoles.

4K is the next big hope for the television and entertainment industry, after 3D once again failed to capture a mainstream audience. The capability to deliver 4K streams could give internet services such as Amazon and Netflix an advantage over conventional broadcasters, who don't yet have the bandwidth or receiving equipment to deliver 'live' 4K television into our living rooms. Sky was reportedly engaged in trials of 4K broadcasts earlier in 2014, but has yet to announce a set-top box capable of delivering Ultra HD.



Amazon Video may have caught up with Netflix in the race for 4K, but only select Sony TVs currently support it

# Mouse-Box fits entire PC in a mouse

**A POLISH COMPANY** has come up with a fresh twist on the ever-shrinking PC by building one into the body of a mouse. Dubbed the Mouse-Box, the device is pitched as a portable computer that can be plugged into almost any display, either via a wired connection or wireless adapter.

The spec of the prototype device contains a quad-core 1.4GHz ARM Cortex CPU (which means the device will likely be restricted to Linux or the now almost defunct Windows RT operating systems), 128GB of flash storage, 802.11bgn Wi-Fi, twin USB3 ports and a Micro HDMI port. The mouse can also use a "wireless image transfer module compatible with any monitor equipped with HDMI/VGA/DVI ports", according to the firm's website.

The Mouse-Box website suggests the device uses some kind of inductive pad to charge the optional battery wirelessly, although presumably it can also be powered via the USB cable, which could make mouse operation awkward, especially if it's running a second cable to a display.

The Mouse-Box's inventors have produced a video which suggests the Mouse-Box could be the ideal tool for office slackers, hoodwinking their boss into thinking they're working while actually getting up to no good using the

With the Mouse-Box, you'll be able to carry your PC with you wherever you go



Mouse-Box, simply flicking the display back to the work PC when the supervisor appears over their shoulder. They might need to improve their sales pitch if this idea is to catch on, not least because the Mouse-Box's bright red design would stick out like a sore thumb in an office.

The Polish crew behind the device are seeking help to get it on to the market. "Your help is crucial for our team in order to turn the device prototype into a complicated preparation of Mouse-Box for mass production," the website states. "We will be extremely grateful if you would like to support us with your knowledge and improve this project. If you own a firm or work in a firm which appreciates our achievement and can help us to reach our final goal, we kindly ask you to contact us."

There's no suggested price for the Mouse-Box. But if one of the mouse buttons wears out before the PC does, we suspect it will be a touch more expensive to replace than an average Intellimouse.

**palicomp**  
www.palicomp.co.uk  
01270 898104



**Sale price**  
**£429.99**  
**Inc Vat**

(Code - HAS2)

## INTEL Haswell Sphere

INTEL Haswell i5 4430 @ 3.0Ghz (Quad)  
ASUS Z87-K Motherboard  
4GB DDR3 Memory  
500GB Hard Drive  
SONY 24X DVD+-RW  
INTEL HD4600 Graphics



**Sale price**  
**£499.99**  
**Inc Vat**

(Code - EXC4)

## AMD 6Core Farcry3 Gamer

AMD Bulldozer FX-6100 @ 3.6Ghz (Six Core)  
ASUS M5A78L-M/USB3 Motherboard  
PATRIOT VIPER RED V3 8GB 1600Mhz RAM  
1TB SATA3, 6Gb/s HDD  
SONY 24X DVD+-RW  
AMD Radeon HD7770 1GB Graphics



**Sale price**  
**£749.99**  
**Inc Vat**

(Code - PHO11)

## Phoenix i5 Vortex

INTEL Haswell i5 4670K @ 3.4Ghz (Quad)  
Overclocked To 4.4Ghz Per Core  
ASUS Z87-K  
PATRIOT VIPER RED V3 8GB 1600Mhz  
2TB SATA2, 3Gb/s  
SONY 24X DVD+-RW  
nVIDIA GTX660 2GB





## The Winning Species

Trust us to build you a champion's PC for less.

# Three buys O<sub>2</sub> for £10 billion

**SHORTLY AFTER WE** learned BT was planning to buy EE for around £12 billion, another mobile phone operator is up for grabs. This time, it's O<sub>2</sub>, and the interested party is Hong Kong's Hutchison Whampoa, owner of the Three network.

Hutchison is in talks to buy the company from Spain's Telefónica for a potential \$15.4bn (about £10.2bn), a deal that would create the UK's largest mobile network with around 35 million subscribers, ahead of current leader EE's 26 million.

The takeover offer shows further consolidation in the UK mobile market. After the merger of Orange and T-Mobile to create EE in 2010, the number of UK phone operators dropped from five to four, and if the Hutchison deal goes through there will be just three major UK operators.

The deal is sure to come under scrutiny from UK and EU competition authorities, but Hutchison Whampoa isn't worried. Its group finance director Frank Sixt gave the example of Ireland, where Hutchison took over O<sub>2</sub> last year. However, Ireland is a much smaller country than the UK with a correspondingly smaller mobile phone market, so we don't feel a direct comparison can be made.

The deal would also affect the virtual mobile operators that use O<sub>2</sub>'s infrastructure, such as popular community-owned network Giffgaff, which has just launched its own 4G service.



➤ After being rejected by BT, O<sub>2</sub> will now end up in the hands of Hutchison Whampoa, the owners of Three

TalkTalk and Sky were also reported to be preparing a bid for O<sub>2</sub> after reports in the Spanish media suggested that both companies were interested in the mobile network. Sky has previously expressed doubts about entering the mobile market, but given that both BT and Virgin Media will be in a position to offer customers bundled broadband, television, landline and mobile packages, Sky may feel it has little option but to join them in the future. TalkTalk already has a mobile proposition, but only as a virtual network that piggybacks on Vodafone's network.

## Sky to censor customers' broadband by default

**SKY WILL CENSOR** the internet connections of its 5.3 million broadband customers, unless they specifically choose to switch off the company's Broadband Shield. The company, like all Britain's major broadband providers, has been offering the network-level content filters as an optional extra to customers since last year.

Now, in what amounts to de facto censorship of the internet by the country's second biggest broadband provider, Sky will switch those filters on unless customers specifically opt out.

"What we're doing now is simply making sure that the automatic position of Sky Broadband Shield is the safest one for all – that's 'on', unless customers choose otherwise," said Sky brand director Lyssa McGowan in a blog post.

Customers will be asked if they want to switch on the broadband filters. If they fail to respond, the filters will be automatically switched on. "Once Sky Broadband Shield is active, users cannot access a filtered site unless they log in and alter their settings,"

➤ Sky's broadband filters will be switched on automatically unless customers opt out

McGowan explained. "They can browse away from the filtering page to visit freely any site suitable for the 13 age rating, without any interruptions."

Sky says customers can switch off the filters at any time and they won't be pestered thereafter. "It's better for people to make their own choice, but until they do, we believe this process to be the safest one," said McGowan. "Meanwhile, we can ensure that they're protected from phishing, malware and sites unsuitable for young children."

"We're happy to act in the interest of customer security and online safety. Knowing our customers and the internet as we do, we believe this is the right and simplest solution to a problem we all know is out there."

The default 13 age rating blocks sites concerned with dating, file-sharing, violence, drugs, 'criminal skills', suicide, self-harm, pornography and more.

It will also protect against phishing and malware attacks.

Research published by Ofcom in January claimed only 21 per cent of parents were using parental controls. A quarter of the parents surveyed said they believed their children could bypass the filters.



# Nvidia launches mid-range Full HD GeForce GTX 960 graphics card

**NVIDIA HAS REVEALED** the GTX 960, the first mid-range card in the 900-series that aims to provide enough graphics muscle for Full HD gaming without also demanding significant power draw or cooling.

The GTX 960 is based on Nvidia's energy-efficient Maxwell architecture, which powers the high-end GTX 980. The GM206 GPU has 1,024 CUDA cores running at 1,127MHz, with a boost speed of 1,178MHz. This is paired with 2GB of GDDR5 RAM via a 128-bit memory bus. Nvidia claims the GM206 delivers more performance than the equivalent Kepler GPU at twice the efficiency, meaning the 128-bit memory bus shouldn't be a limiting factor as long as you stick to 1080p resolutions.

The GTX 960 should be twice as powerful as a GTX 660, which Valve identified as one of the most popular on the planet in its Steam hardware survey, and the one preferred by most competitive game players.

Nvidia has prioritised heat and power efficiency with the GTX 960, to the point that it requires only a single 6-pin PCI-Express connector and has a very low 120W Thermal Design Point (TDP). Better yet, when playing games such as League of Legends, Dota 2 or StarCraft II (in other words, top-down strategy titles that aren't particularly GPU-intensive), the card should only consume around 30W of power. With so little heat being generated, the cooling fan can stop

◆ The Nvidia GeForce GTX 960 is designed to replace the GTX 660, one of the most popular graphics cards used by MOBA and RTS gamers



spinning altogether for silent gaming. Only more demanding 3D games should force the fan to start spinning.

If you want extra visual clarity, the GTX 960 has enough power to use Nvidia's Dynamic Super Resolution (DSR) to upscale games to 4K resolutions, before resampling them for your display's native frame rate. According to Nvidia, it can run League of Legends at a 4K resolution, downsampled to a 1080p display, at higher frame rates and with sharper visuals than the GTX 660 running at a native 1080p with 8x MSAA.

As we've come to expect from the 900-series range, the GTX 960 will include support for Nvidia's GeForce Experience software. This tool can optimise the visual settings of supported games for the best frame rates on your particular hardware, stream gameplay to an Nvidia Shield handheld or Shield Tablet, and record gameplay for streaming online or uploading to social networks. It will also play nicely with G-Sync monitors for smooth gameplay regardless of frame rate.

HEVC and H.265 video encoding and decoding, combined with HDMI 2.0 and DisplayPort 1.2 video outputs, mean the GTX 960 is also ready for 4K video playback, as soon as content actually arrives. It also supports the upcoming DirectX 12 API and OpenGL 4.4, so will be up to date when Windows 10 arrives later this year.

The Nvidia GTX 960 is available now, with prices starting at around £160 depending on whether manufacturers have used a custom cooler or overlocked the GPU out of the box.

# Microsoft HoloLens signals future of augmented reality

**GOOGLE GLASS MAY** have gone off sale in January, but Microsoft has a brand new pair of smart glasses to get excited about. HoloLens uses Windows 10 to create pseudo three-dimensional holograms in your immediate surroundings. While Microsoft calls it the world's first holographic computing platform, HoloLens is more akin to an advanced form of augmented reality, as you still need glasses to see the 3D models.

Alex Kipman, the man behind Microsoft's Kinect device for Xbox One, demoed the headset. The untethered headset is large, but doesn't require any wires, phones or a connection to a PC to work. It also has see-through high-definition lenses, spatial sound so you can view and hear the so-called 'holograms' even when they're behind you, and sensors to detect where you are in relation to your surroundings.

HoloLens needs a high-end CPU and GPU to work, but Microsoft said it needed a third 'holographic' processor as well in order for the device to truly understand the world around you, so it created the Holographic Processing Unit (HPU). This can understand what you're doing, where you're looking, your gestures, your voice and the ability to spatially map the world around you. It can also supposedly process terabytes of data in real-time, all without wires or external cameras.

Kipman said every Windows 10 device will have APIs focused on human and environment understanding, so holographic APIs will be enabled inside every Windows 10 build. 'Holograms' are universal apps in Windows 10, too, so other apps will be able to work with Holographic, including Netflix, Minecraft and Skype. This means you'll be able to bring 3D models of the app, such as a makeshift TV screen for Netflix, into your living room and interact with it using gestures and voice commands.

The demo showed the Holo Studio app, which lets you create your own objects and 3D-print them once you're finished. However, another camera rig had to be present so the audience could see through the



Goodbye Google Glass, hello Microsoft HoloLens

eyes of the HoloLens, further confirming this is actually taking place in augmented reality rather than a hologram you can see in the flesh.

Microsoft's promo reel for the HoloLens also hinted that other non-HoloLens-wearing users would be able to interact with what other people see through their glasses by using a tablet or PC, such as being able to talk someone through replacing a sink trap pipe over Skype by circling where to tighten certain coupling nuts on their tablet.

Microsoft didn't give an exact release date for the HoloLens, but said it will launch some time during "the Windows 10 time frame".



# Windows 10

## Latest features revealed

Microsoft has unveiled a raft of exciting features for its new operating system – and it's shaping up to be the best version of Windows yet

**MICROSOFT HAS REVEALED** some of the latest features in Windows 10, showing for the first time how its new operating system will work across PCs, tablets and mobiles.

Speaking at the Windows 10 Briefing in Redmond, Microsoft vice-president Joe Belfiore took to the stage to demonstrate Windows 10 in front of a live audience.

### START AGAIN

As we noted in our Windows 10 Technical Preview feature in *Shopper 323*, the big news is the return of the Start menu in Desktop mode. Compared to the Technical Preview, the Start menu has had a bit of an overhaul.

In the Technical Preview, you could switch between a Windows 7-style Start menu and a Windows 8-style Start screen depending on whether you were on a PC, laptop or tablet. In the latest version, the Start menu still has live tiles on the right and a list of apps on the left, but the Start menu can now expand to fill most of the desktop. The expanded mode is better suited to touchscreen devices, and it's good to see a unified Start menu design.

On desktop and laptops, an updated Action Centre has replaced the Charms Bar. Similar to the notification bars on iOS and Android phones, this shows notifications from various apps, such as social media updates, Skype calls, recently installed apps and your calendar. Notifications are expandable, so you can see images attached to messages, for example, or interact with them.

The Action Centre also has expandable icons that provide shortcuts to features such



↑ The Start menu can now be viewed in full-screen mode on both tablets and desktops

as airplane mode, Wi-Fi, brightness, tablet mode, VPN settings and screen rotation.

In previous builds, the computer's settings were still split between the traditional Control Panel and the PC Settings app, as present in Windows 8.1, which is needlessly confusing. However, Belfiore announced that Windows 10's Settings menu will now combine the two menus into a single UI, which should please fans of both Windows 8 and Windows 7.

### CONTINUUM

Belfiore also revealed more about Windows 10's Continuum feature. This is designed to make Windows 10 work seamlessly on hybrid

laptop/tablet devices such as the Surface Pro 3, which will switch from desktop to tablet mode when you undock it from its keyboard. When Belfiore removed the Surface Pro from its keyboard, a small pop-up appeared asking if Windows should switch to tablet mode.

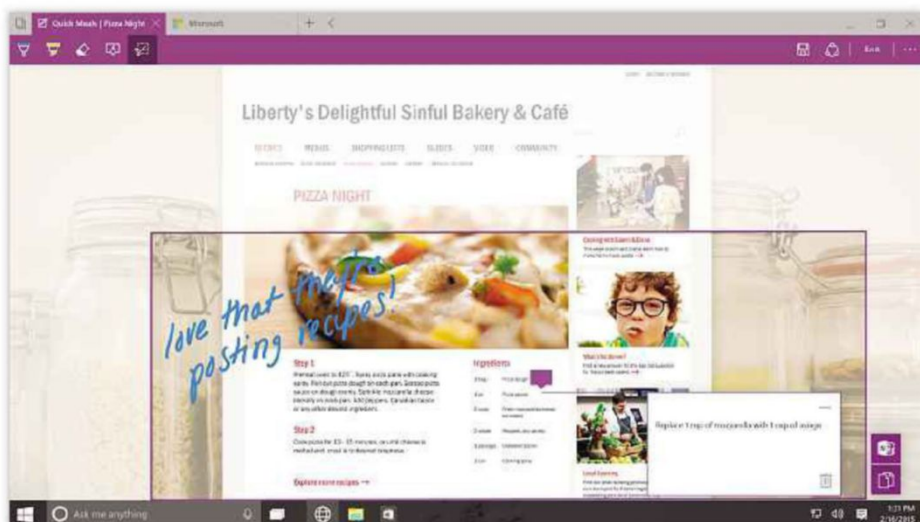
Once tablet mode was enabled, all the windows on the desktop went full screen. To switch windows, you can swipe from the left and select the window you want to look at. Tapping the Start button will automatically bring up the full-screen Start menu interface, giving you greater access to all your live tiles.

It works the same in reverse. Once you've finished using your device in tablet mode, reattaching the keyboard will prompt another request to transform back to desktop mode, and all your windows will reappear as they were before you switched to tablet mode.

Standalone tablets will also use this tablet interface, and you'll also be able to run two apps simultaneously in split-screen mode. Tablets will also have access to the traditional desktop mode, so you can plug in a keyboard and mouse and use it like a normal PC.

### CORTANA COMES TO PC

Cortana, Microsoft's personal digital assistant, will be present in Windows 10 PCs. Previously confined to Windows Phones, where it took the form of a Siri-style voice-activated helper, Cortana works in a similar way on your desktop. You'll find Cortana in the Search box in the taskbar, and you can speak to it directly to ask questions and search the web via Bing, as well as type in commands manually.



↑ You can comment on web pages and share them with friends straight from the Spartan web browser

As with the mobile version, the PC version will have its own notebook containing all the information you want Cortana to know about you, but you can change this at any time. When you open the notebook, you'll see news headlines that are relevant to your interests, such as stock market updates, the weather forecast or appointments in your calendar.

Cortana has a few PC-exclusive functions, such as being able to play music or search through storage locations including your local hard disk and OneDrive for documents, images and files. You'll also be able to search for specific groups of files, too, such as 'photos from December'. Your search results will be separated into apps, settings, photos, videos, music and email tabs, as well as a general files tab that shows everything.

Cortana can filter results to give you the most relevant result. When Belfiore typed in Skype, for example, Cortana's first result was the Skype app installed on the PC, but there was also a link to the Skype website and a handful of different web searches that might help if you were having trouble setting Skype up or making a call. In other cases, Cortana might provide settings options instead.

Cortana can even send quick emails for you via voice control. You'll need to add your own verbal punctuation, but it certainly worked very well during Belfiore's live demo.

## PROJECT SPARTAN

Windows 10 will have a new universal internet browser that works in a similar fashion across all devices. Currently codenamed Project Spartan, it has a new, streamlined UI and a brand-new rendering engine.

The first big new feature is Note-Taking mode, which lets you draw straight on to web pages with your finger or a stylus if you have a touch device. Alternatively, if your device doesn't have a touchscreen, you can type comments using your keyboard instead.

Once you've marked up a page, the page onscreen is frozen (although links will still be live) and you can then share it with friends or save it. If you don't want to save the entire page, you can crop and save a segment and save it to OneNote, copy it to the Clipboard, or swipe in from the right and use the browser's built-in sharing tools to post it quickly to Twitter, Facebook, Evernote, Flipboard and a whole host of different apps.

Spartan also has a Reading Mode, where

websites will be transformed into a standardised format that condenses the main images and text into a simpler interface that's easier to read, eliminating adverts and large chunks of white space.

A reading list has also been added into the browser, which will be synced across every Windows 10 device you have. This means you'll be able to save articles on your PC, for instance, to read later on your phone while you're on the way home. More importantly, articles saved to the reading list will be available offline, so you don't have to use any bandwidth to read them. The reading list will also support PDF files, so you can mark them up with notes and annotations and save them offline for when you need them.

Cortana will make an appearance in the Spartan web browser, too. It will provide smart responses when you're typing words

into the address bar, such as weather forecasts if you type in 'weather', for example, but it will also be able to perform more complex tasks. For instance, if you've asked Cortana to track a flight and then start typing in the name of the airline in the Spartan browser, Cortana will pre-emptively provide you with what it thinks is the correct link to answer your potential search query.

Cortana can also tell you things about certain pages you're looking at. If it's learned something about a site, such as a restaurant, a small icon will appear in the top-right of the browser, which can be expanded to show information such as directions from your current location, restaurant reviews,

images, reservation details and opening hours. Highlighting certain words will also prompt Cortana to do a quick web search for its meaning, so if you're unsure about a particular ingredient, for example, it will be able to tell you what it is and provide you with extra nutritional information.

## WINDOWS 10 GOES MOBILE

On Windows Phones and smaller tablets under 8in, Windows 10 looks a little different. The Start screen is very similar to the current Windows Phone live tile interface, but now your background image will bleed fully across the entire screen, not just certain live tiles.

Pan to the right and you'll be presented with a revamped apps list. Apps are still listed in alphabetical order, but recently installed apps have been prompted to the top of the screen so you can find them more easily.

Likewise, the pull-down Action Centre that made its debut in Windows Phone 8.1 is now synced to your PC, so you'll be able to dismiss notifications across all your devices in one action. Belfiore also said that Settings is now a universal app, so it looks exactly the same on phones as it does on your PC, ensuring that you'll be instantly familiar with where everything is.

Moving to the Messaging app, Belfiore showed how you can now pull the keyboard over to the right side of the screen on larger phones and small tablets so you can type out messages or 'shape write' them with one continuous finger movement single-handedly.

Windows 10 for phones will also have voice support, so you can speak your message aloud instead of typing it out by hand.

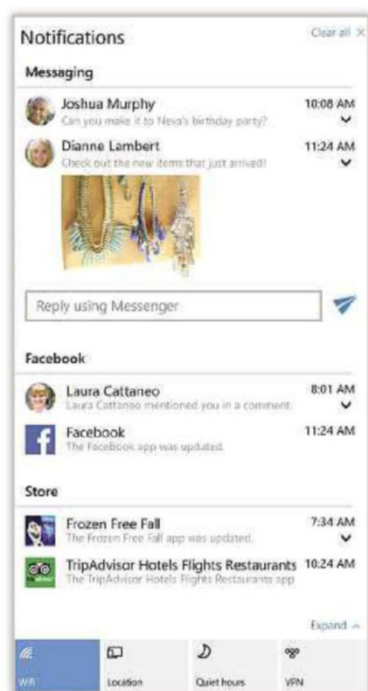
Microsoft's enhanced voice-recognition software can recognise contacts and Twitter hashtags, and can put punctuation at the end of a sentence automatically. Belfiore confirmed that Skype and other IP messaging services will be integrated into Messaging, so you'll be able to see when contacts are typing messages before you receive them.

## FREE UPGRADE

Microsoft was very careful not to use the words 'Consumer Preview' in its January briefing, so you'll have to wait a little longer before you can try out Windows 10 for yourself. However, it did say that all these new features would be gradually made available to anyone currently on the Windows Insider Programme over the next couple of months. The latest build for Windows Insiders is available now, and the first technical preview for phones will arrive in late February.

There's good news for anyone currently running Windows 7 or Windows 8.1, too, as Microsoft has promised a free upgrade to Windows 10 for anyone who upgrades in the first year after launch. Even better, Microsoft said it will keep that particular device current for its supported lifetime at no additional cost once you've upgraded. New features will be delivered when they're ready rather than in the next major release, and the arrival of universal apps means that, theoretically, developers need build only one version that they can then update simultaneously across all your different devices.

We still don't know how Windows 10 will work on Xbox One yet, but Microsoft said it will reveal all at this year's Game Developers Conference in March. ☐



➔ Swipe in from the right to find Windows 10's all-new Action Centre



# AMD FreeSync vs Nvidia G-Sync

How does adaptive sync work, and which technology should you buy? We investigate

**SCREEN TEARING IS** one of the biggest irritations facing PC gamers today. It's a huge annoyance for players who want smooth graphics and quick response times in fast-paced games such as FPS and RTS titles, but the problem affects games and gamers across the board, and from budget PCs to high-end monsters. It's a crisis that graphics card and monitor makers have finally come together to fix.

Nvidia and AMD are both offering solutions to this problem. The technologies are called adaptive sync or dynamic refresh rates. The two firms market their technologies differently, but they solve the same problems in precisely the same way; it's the hardware implementations that vary slightly. In this article, we'll explain how the technology works and give you something to think about if you're in the market for a new monitor or graphics card.

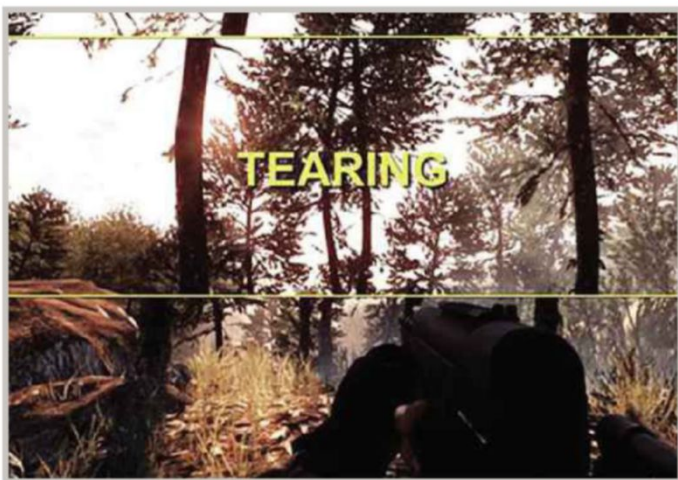
Nvidia got the jump on AMD last year when it launched its first consumer monitors with built-in adaptive sync, which it calls G-Sync. AMD, meanwhile, has been talking about its own adaptive sync technology, called FreeSync, for a long time, and finally looks set to push a flurry of FreeSync-compatible monitors on to the market this year.

However, it's not all rosy. Although consumers will soon have a choice of technologies to choose from – and competition is usually a good thing – the camps are very much divided. Nvidia cards won't work with FreeSync monitors, and AMD cards won't work with G-Sync monitors. This leaves consumers with a tricky dilemma, as your choice of monitor will potentially lock you to one graphics card manufacturer for the life of the display.

Before we get into the details of each system, though, let's take a look at the problems solved by adaptive sync.

## FRAME TEARING

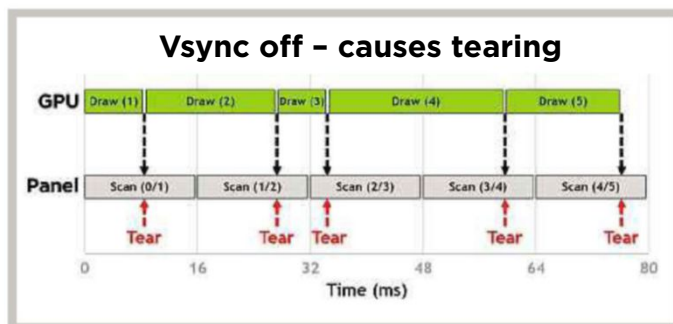
Gamers with high-performance systems often run into the problem of frame tearing. This is caused by the refresh rate of the monitor being out of sync with the frames being produced by the graphics card.



↑ Screen tearing breaks up the image onscreen, making games less immersive and harder to play

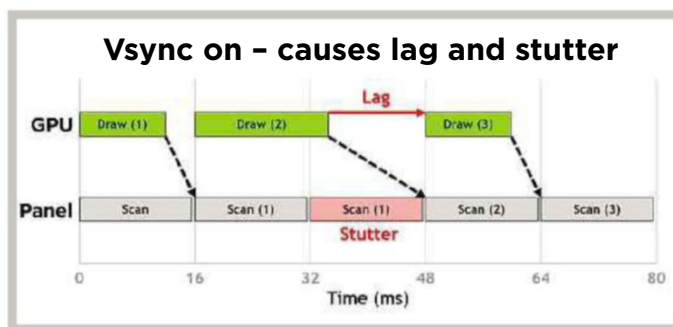
A 60Hz monitor refreshes 60 times per second, but your graphics card's output will vary because of the varying load onscreen events subject it to. As a result, when your screen refreshes, the graphics card may have only drawn part of a frame so you end up with two or more frames on screen at once, which results in distracting jagged-looking images when there's fast-paced action on the screen.

This can easily be solved by turning on vertical sync (Vsync) in-game, which forces the graphics card to match the refresh rate of



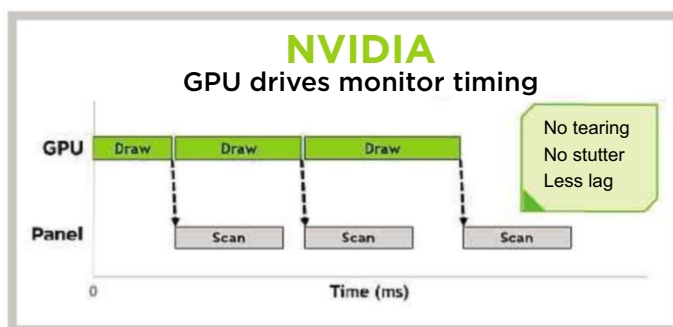
↑ Frame tearing is caused by an out-of-sync graphics card and monitor panel

the monitor, typically producing 60 complete frames per second. However, many cards can't keep up with this, but because they have to send 60 full frames each second, some of the frames are repeated until the next frame has been fully drawn. This leads to input lag and stuttering that for many is even more unpleasant than screen tearing.



↑ Stuttering caused by Vsync

Because graphics cards and monitors don't really talk to each other in any meaningful way other than to share basic information, there's no way to sync the frame output and the refresh rate of a monitor. G-Sync and FreeSync solve this problem in the same way, although they both use slightly different technology to do so.



↑ Adaptive sync controls when your monitor refreshes

With G-Sync and FreeSync, the graphics card and monitor can communicate with one another, with the card able to control the refresh rate of the monitor, meaning your 60Hz monitor could become, say, a 49Hz, 35Hz or 59Hz screen, changing dynamically from moment to moment depending on how your graphics card is performing.

This process eliminates the stuttering from Vsync, and also eliminates frame tearing because the monitor is only ever refreshing when it's been sent a fully drawn frame. The impact is obvious to see,

incredibly impressive and is particularly strong on mid-range machines with fluctuating frame rates. High-end machines will benefit, too, although not to such a great degree.

## DISPLAYPORT DIVIDE

Nvidia was first to the market with its G-Sync technology, with launch partners including AOC, Asus and Acer. The technology is impressive but it has a major, and expensive, drawback. In order to be G-Sync-compatible, the screens need G-Sync-specific hardware that's rather expensive, adding around £75 to the price of any given monitor.

FreeSync, which is an AMD technology, uses the Adaptive Sync standard built into the DisplayPort 1.2a specification. Because it's part of the DisplayPort standard decided upon by the VESA consortium, any monitor with a DisplayPort 1.2a input is potentially compatible. That's not to say that it's a free upgrade; specific scaler hardware is required for FreeSync to work, but the fact that third-party scaler manufacturers including Realtek, Novatek and MStar have signed up to make FreeSync-compatible hardware should mean that pricing is competitive. Furthermore, AMD has told *Shopper* that there are no additional licence fees required from manufacturers in order to use FreeSync (hence the word 'Free' in the name).

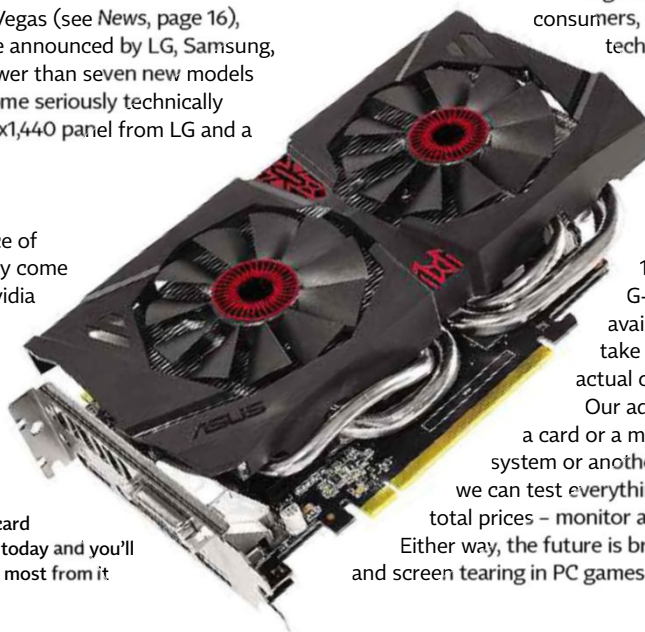
While DisplayPort 1.2a is an open standard that can be used by anyone, Nvidia's latest 900-series graphics cards don't use it, with the company saying it's going to continue focusing on G-Sync instead. Some monitor manufacturers are sticking with Nvidia for now, too. Acer, which has already announced a few G-Sync monitors, currently does not have plans to launch DisplayPort 1.2a monitors. Asus, meanwhile, has also not announced any 1.2a-compatible monitors either. AOC told *Computer Shopper* that it plans to launch FreeSync-compatible monitors later this year.

Meanwhile, at this year's CES in Las Vegas (see *News*, page 16), FreeSync/DisplayPort 1.2a monitors were announced by LG, Samsung, Nixeus, BenQ and ViewSonic, with no fewer than seven new models due to launch this year. These include some seriously technically impressive panels such as a 144Hz 2,560x1,440 panel from LG and a 31.5in Ultra HD panel from Samsung.

## GRAPHICS CARD SUPPORT

With such similar technology, your choice of monitor and graphics card may ultimately come down to your current situation. Older Nvidia and AMD cards (including the graphics built into AMD processors) can be updated to work with G-Sync and FreeSync monitors, so your current setup may be ready without the need to buy a new graphics card.

◆ The new Nvidia GTX 960 is a great card (full review next month), but buy one today and you'll also want a G-Sync monitor to get the most from it



## AMD

According to AMD, the following existing GPUs will be able to use FreeSync for dynamic refresh rates in games (after a software update): Radeon R9 295X2, 290X, R9 290, R9 285, R7 260X and R7 260. Other cards/chipsets will support FreeSync, but only for "video playback and power-saving purposes". These include the Radeon HD 7000, HD 8000 and R7 and R9 series cards, and APUs from the Kaveri, Kabini, Temash, Beema and Mullins lines.

## NVIDIA

Plenty of older Nvidia cards are compatible with G-Sync. The full list of cards is as follows: GeForce GTX 980, 970, Titan Black, Titan, 780 Ti, 780, 770, 760, 750 Ti, 750, 745, 650 Ti Boost, 660, 680, 670, 690, 660 Ti.

The most important thing to take away from this is that even fairly old mid-range cards from both AMD and Nvidia both support adaptive sync. This means you don't need to buy a new card to reap the benefits of either technology. The lineup of monitors supporting FreeSync is already enviable (on paper), but there are some great G-Sync monitors on the market right now from Acer, Asus and AOC.

The problem is the incompatibility of the two systems. If adaptive sync is important to you and you're looking to buy a new graphics card or monitor, you should wait and see how the market develops, how much new G-Sync and FreeSync monitors cost, and how different the two technologies end up being. It's a confusing time for consumers, which is a shame because the technology itself is so incredibly useful.

If you're buying a new graphics card and have an adaptive sync monitor in mind, AMD looks to be in a strong position. Adaptive sync greatly benefits modest hardware, and those with mid-range cards will appreciate the lower cost overheads a DisplayPort 1.2a monitor looks to have over a G-Sync one. However, they aren't available yet, and G-Sync monitors might take a tumble in price once there's some actual competition on the market.

Our advice for now is to wait, as buying either a card or a monitor today will lock you into one system or another. Once FreeSync monitors are on sale, we can test everything as it would be used, and compare total prices – monitor and card – to see which is better value. Either way, the future is bright for adaptive sync technologies, and screen tearing in PC games should soon be a thing of the past. ☑

## Freesync Monitors Announced at CES 2015

Manufacturer	Model	Size	Resolution	Rate
BenQ	XL2730Z	27in	QHD (2,560x1,440)	144Hz
LG	29UM67	29in	2,560x1,080	75Hz
LG	34UM67	34in	2,560x1,080	75Hz
Nixeus	NX-VUE24	24in	1080p	144Hz
Samsung	UE590	23.6in, 28in	4K	60Hz
Samsung	UE850	23.6in, 28in, 31.5in	4K	60Hz
ViewSonic	VX2701mh	27in	1080p	144Hz

Our advice for now is to wait, as buying either a card or a monitor today will lock you into one system or another



# REVIEWS

## YOUR TRUSTED GUIDE TO WHAT'S NEW

### VIRTUAL REALITY HEADSET

## SAMSUNG Gear VR



£190 inc VAT • From [www.clove.co.uk](http://www.clove.co.uk)

### VERDICT

Brilliant and breath-taking at first glance, but limited content makes it a novelty for now

**SAMSUNG'S GEAR VR** is the closest thing yet to a consumer VR headset. This 'Innovators Edition' is a device for early adopters, enthusiasts and developers, yet it's slickly designed, both in terms of hardware and software. Anyone is free to buy a Gear VR online and Samsung has even launched an app store, called Milk VR, for the device.

Much like Google's Cardboard VR concept, Gear VR works in tandem with a smartphone. The bad news is there's only one compatible model, Samsung's own Galaxy Note 4; the good news is it's an excellent phone so you won't be selling yourself short by getting one.

The headset costs £190 on its own, or £220 with a gamepad controller. That would be quite a bit for a device that simply holds a phone to your head, as Cardboard does, but there's a lot more to Gear VR: it has built-in head-tracking sensors using technology licensed from market-leader Oculus Rift.

### IMMERSION THERAPY

Everyone we tested the headset on was staggered, sometimes quite literally, by the experience. It's hugely impressive and



genuinely immersive, whether you're on stage with Cirque du Soleil, following a herd of giraffe from a helicopter or perched vertiginously above the Las Vegas strip. Based on this, it looks inevitable that VR will grow rapidly over the next few years.

Oculus's head-tracking technology is spot on, accurately reproducing head motions, while the Note 4's high-resolution 2,560x1,440 display is capable of sharp visuals. The OLED screen updates quickly and has excellent image quality. The headset has a small touchpad on the side to let you navigate menus and select content. A Micro USB connector lets the phone and headset communicate, and a light sensor turns the display off automatically when it's not in use.

The headset and phone together provide a respectable 96° field of view. The lack of peripheral vision is a bit disconcerting at first, but the head tracking is good enough to make it less of an issue. Our only gripe with the Gear VR is focusing. However much we played with the focusing ring on the top of the headset we couldn't get the whole image in sharp focus, only the centre section.

Weighing in at 550g with the phone attached, it's comfortable to wear for short periods of time. Around 100g of that weight is in the straps, which still leaves a significant weight hanging from the front of your face. A warning to the vain: with three straps, this VR headset will mess up your hair pretty quickly.

It takes quite a while to find a position on your head that's both comfortable and keeps everything onscreen as crisp as possible. Once

you get the headset how you like it there's little need to take it

off, as you can use the Note 4's camera to pass through a windowed view of the world at 60fps, so you can grab a drink or snack easily. The straps are easy to remove if you want, giving you a more social device that can be handed round to others. Used like this the Gear VR really comes into its own, with everyone desperate to have another go.

### VIRTUAL WORLDS

The Gear VR comes with a 16GB microSD card with some VR content preloaded on it, including photos, videos and games. VR content takes up quite a bit of space, so having a separate memory card to pop in your phone for VR makes a lot of sense.

Panoramic 360° photos may not be the most exciting VR content by they are still the most effective and varied, and you can easily find such images online and load them on to your phone. The sense of presence is palpable, and we couldn't get enough of this kind of virtual tourism. The resolution of such photos is way ahead of any game or video content, and their stillness gives you a chance to appreciate that detail. VR experiences based around still images also work well, letting you navigate through environments by moving from one fixed point to another.

Most of the video available looked very compressed. Some clips were of a good standard but many simply weren't taken from high enough resolution sources to convince. The Note 4's hardware is certainly capable of playing high-quality video, but attempting to

◀ The Gear VR's three head straps are likely to mess up your hair





p36 | Samsung Galaxy Note Edge



p41 | Canon EOS 7D Mark II



p50 | Creative Sound Blaster X7



p54 | BT Mini YouView Box



p62 | Elite: Dangerous

## The future of VR

Gear VR is an impressive piece of kit but it's currently held back by a lack of content. That's about to change, though, with Samsung recently announcing it had signed a deal with the NBA to provide VR content from basketball games.

The content will start with pre-recorded courtside segments. This will give fans the best seat in the house, able to see the players from only a couple of metres away, as well as the ability to turn and see the crowd behind them. It's heady stuff for basketball fans overseas, many of whom can only dream of attending games. Even local fans of big teams might never get this close to the action.

Basketball may not float your boat, but imagine the same concept rolled out to UK sports such as football, rugby or cricket. The best seat in the stadium could be rigged with VR cameras and then sold innumerable times to those who want to attend the game virtually. Virtual season tickets could be sold,



↑ NBA games should be among the first to be broadcast in VR

and actual season tickets could come with a virtual add-on for those games you just can't make.

Gear VR is arguably a good enough bit of kit to make this financially viable today, though better headsets with crisper video would certainly help. A bigger issue is streaming all that video data to your home; given the requirement for at least 60fps video at very high resolutions in 360°, the bit rate will trouble even the fastest internet connection.

Extend the idea out to bigger events such as F1 and the possibilities are immense. With multiple VR spots to switch between, you could swap between the nose of a car, the pits, the grandstand and Copse Corner; now that would be some way to appreciate the British Grand Prix. Don't like sports? Then how about a front seat at the theatre or even on stage at a gig? VR may not be the most social experience, but it's going to be huge nonetheless.

stream video from the Milk VR store was a disastrous. Downloads are better quality, but Samsung quickly needs to find more good content if it's going to hold people's attention. But then this headset was always intended to drum up interest rather than fulfilling it.

The Oculus Cinema app lets you watch 3D movie trailers while seated in a choice of virtual movie theatres. You can also watch your own films this way, whether they're 3D or not. At present there's no simple way to watch 3D content directly from YouTube on the headset. However, YouTube has recently announced that it plans to add support for 360° movies to the service, so we should

see better compatibility between the video service and the Gear VR device soon.

A reasonable range of games is available, though most are of the simple look and shoot variety. There's not much support for the optional game controller, presumably as developers don't want to further divide a small pool of users. If you're looking to play games on a VR headset we highly recommend you try out Oculus Rift instead.

### A VIRTUAL FUTURE?

We've resisted comparing Samsung's Gear VR against its step-sibling, the Oculus Rift DK2 (which uses the display from last year's Galaxy Note 3). Oculus is the trailblazer in VR, and now the company is owned by Facebook it has the financial muscle to break into the mainstream. However, the Development Kit 2 headset costs \$350 (plus shipping from the US and VAT) and isn't a consumer product.

The DK2 has to be hooked up to a PC in order to work, as it's a VR display rather than a standalone device. Anyone who's happy to tinker with applications and games will have a whale of a time with the DK2; just take a look on YouTube to see what's possible. That said, a more advanced development version, Crescent Bay, has already been demoed, and a consumer

device should hopefully launch some time this year, so we'd wait a few months if you can.

The Samsung Gear VR is one of those bits of kit that makes us glad to be technology journalists. It's great fun when it lands on your desk, but few should consider actually buying one. The current content means it's not a lot more than a novelty. However, if you own a Galaxy Note 4 and like the idea of VR, it's tempting. As VR is such a fast-moving area, the Gear VR could quickly be left behind once a consumer headset from Oculus is launched later this year or in 2016.

Seth Barton



### SPECIFICATIONS

#### HARDWARE (\* FROM GALAXY NOTE 4)

RESOLUTION 2,560,1,440\*

SCREEN TECHNOLOGY OLED\*

FIELD OF VIEW 96°

LATENCY 20ms

INTERFACE Touchpad and back button

VIDEO INPUTS None

AUDIO INPUTS None

AUDIO OUTPUTS Minijack\*

DIMENSIONS 198x116x90mm

WEIGHT 550g

WARRANTY Five years RTB

DETAILS [www.samsung.com/global/microsite/gearvr](http://www.samsung.com/global/microsite/gearvr)

PART CODE SAM-GV



# ALIENWARE Area-51



£3,500 inc VAT • From [www.dell.com/uk](http://www.dell.com/uk)

## VERDICT

The Alienware Area-51 is one of the most eye-catching PCs to come along in a while – and it's an absolute powerhouse too

**IT'S NOT OFTEN** a computer case radically departs from the standard ATX layout, so for that reason alone the Alienware Area-51 gets kudos. In a sea of drab black towers, the radical and unmistakable 'triad' is refreshing.

You could be forgiven for thinking the outlandish shape dictated the overall design, but Alienware claims it was a by-product; optimal thermal management and improved ergonomics were the deciding factors in using the triangular chassis. Designed to rock back and forth on its base for easier access to the front and rear ports, anyone used to struggling to find USB ports on the back of the system will find it a welcome break from the norm.

## CORNER STONE

Each corner can sustain five times the system's weight, which is reassuring as the Area-51 is a very heavy system if fully specified. Handles at the top and on the base make it easier to grab and carry.

The silver triad chassis has LED lighting on the side panels and front panel. These can be customised with a range of colours from the Alienware Command Center software, while games developed with the AlienFX API can automatically control the LED combinations.

A small switch near the rear connectors turns on two further LEDs that illuminate the I/O panel, making it easier to plug in your peripherals. You get Gigabit Ethernet, coaxial

and S/PDIF audio outputs for surround sound and eight USB ports, four of which are USB3. You also get two USB ports on the front, along with an SD card reader and twin 3.5mm audio jacks. The R9 R90X graphics card can output to 2x DVI, HDMI and DisplayPort, so it's easy to connect multiple monitors.

Gaining access to the internals is simply a matter of removing a screw and popping each panel off with release clips. The side panels are interchangeable so you don't need to remember which side is which. It's here the triangular design makes sense: the front intakes blow air across the components at an angle, while a larger exhaust at the back vents out hot air. The shape also gives greater clearance when placed close to a wall, making it easier for the fans to do their job efficiently.

## DRIVE TIME

Storage drives are mounted separately on one side of the chassis, which helps with cable management and airflow. The case supports one 2½in and three 3½in drives. Our system was equipped with three graphics cards and cable management was as neat as we would expect for such a congested motherboard. The fans aren't overwhelmingly loud, but are certainly noticeable during intense gaming.

The base Area-51 costs £1,299, but there's scope for upgrades. You can add Intel's eight-core i7-5960X overclocked to 4GHz and three graphics cards, or two Nvidia GeForce Titan Z cards for a quad-SLI setup.

Our review system had a six-core Intel i7-5930K running at 3.6GHz, which can Turbo Boost to 3.9GHz when thermal limits allow.

It also has three 4GB AMD Radeon R9 290X graphics cards and 32GB of 2,133MHz DDR4 memory. In our multimedia benchmarks, the Area-51 scored 126 overall. Although this is enough power for most desktop tasks, it fell short of the 138 we've seen in other systems.

Alienware systems are geared towards gaming, and it was no surprise that the three-GPU setup provided scintillating gaming performance. It made light work of Dirt Showdown, scoring 140.5fps at 1,920x1,080 with 4x anti-aliasing and Ultra graphics. It even managed a silky



smooth 83fps in Crysis 3 at 1,920x1,080 with 4x anti-aliasing and High quality settings.

At 3,840x2,160, Dirt Showdown managed an astounding 136.4fps with 8x anti-aliasing and Ultra graphics, although in Crysis 3 we had to drop the anti-aliasing to 2x with Low quality textures to get an average of 33fps. We usually use multi-sample anti-aliasing (MSAA) but when using the much less taxing FXAA anti-aliasing method we saw 122.4fps.

## STORAGE SOLUTIONS

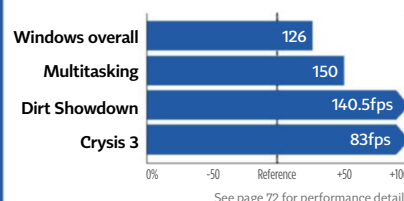
Our system had a 256GB SSD boot disk and a 4TB hard disk, but there are two further 3½in drive bays if you want to add more storage.

If you have deep pockets the Alienware Area-51 is a superb performer and its chassis makes it stand out. If you're not looking to spend as much, the Area-51 can be configured with an Intel i7-5820K processor and Nvidia GeForce GTX 980 for £1,649 inc VAT, although at this price we would also recommend the YoyoTech BlackBox DB3 (see page 33).

Richard Easton

## SPECIFICATIONS

**PROCESSOR** Six-core 3.6GHz Intel Core i7-5930K  
**RAM** 32GB  
**FRONT USB PORTS** 2x USB3  
**REAR USB PORTS** 4x USB3, 4x USB  
**TOTAL STORAGE** 256GB SSD, 4TB hard disk  
**GRAPHICS CARD** 3x AMD Radeon R9 290X  
**DISPLAY** None  
**OPERATING SYSTEM** Windows 8.1  
**WARRANTY** One year RTB  
**DETAILS** [www.dell.co.uk](http://www.dell.co.uk)  
**PART CODE** Alienware Area-51





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- 3 Browse, stream or save files on your mobile devices. The interface includes preview images and key word search, making it fun and simple to use and find your favourite content.



## BUDGET ULTRA-PORTABLE LAPTOP

# ACER Aspire V3-371-380A



£400 inc VAT • From [www.staples.co.uk](http://www.staples.co.uk)

### VERDICT

The Acer Aspire V3-371-380A has a pleasing design and great battery life, but a below average screen

**BUDGET LAPTOPS RARELY** have distinctive designs, as manufacturers abandon creativity for cheaper materials and a low price. Acer's Aspire V3-371 bucks that trend with a genuinely attractive look. At just 1.5kg and 1.7cm thick, it's also very portable.

The white lid is textured with patches that shimmer and shine as you move it around. It looks like it's made from quality material even if it actually feels like plastic. With the lid closed, the small ridge between the bottom of the lid and the back of the laptop makes it easier to see the status lights.

### NO PORTS IN A STORM

USB ports are in rather short supply, with just two on the right edge and only one USB3-compatible connector. There are full-size

The Aspire V3-371 is powered by a low-voltage Intel Core i3-4158U processor, with 4GB of RAM, which is enough for basic tasks. Challenge the dual-core processor to a web page with lots of elements such as video, adverts or animated GIFs and you'll need to wait a few seconds, but this is true of all cheap laptops and most websites load just fine. In our benchmarking tests the Aspire V3-371 managed an overall score of 38, so if you want to do image or video editing you'll definitely need to buy a more powerful laptop.

## The Aspire V3-371 looks and feels a little toy-like thanks to cheap, shiny plastics and a shallow keyboard

HDMI and Gigabit Ethernet ports here, too. On the left there's an SD card reader and a combined 3.5mm headset port. The built-in speakers are relatively loud but lack bass presence. Music and speech is clear, though.

Inside, the Aspire V3-371 looks and feels a little toy-like thanks to cheap, shiny plastics and an unsatisfyingly shallow keyboard. Typing for long periods gets tiresome because the keys bottom out so quickly, but we didn't have any problems with missed keystrokes.

The all-in-one touchpad isn't great. Tapping and pressing the mouse buttons works fine, but multifingered gestures are cumbersome. This is because there's a dead zone where the touchpad won't respond until you've moved your two fingers slightly, which we found irritating. We're hoping this is a driver issue that may be fixed in the future.

One upshot of this low-power processor is battery life: in our moderate use test, which involves scrolling through web pages and playing video, it lasted 11h 3m, well above the seven hours claimed by Acer. In real terms, you should be able to get a full day of work out of this machine without any problems.

### PUT THE BOOT IN

You get a 500GB hard disk in this model, which surprisingly also comes with 8GB of SSD cache. This helps Windows 8.1 to boot quickly; we measured it at 13 seconds from a cold boot to the Windows Login screen. A further 16 seconds are required to log on and finish the startup process.

Unusually for a low-end processor, the Core i3-4158U has an Intel Iris Pro 5100 graphics chip, which deviates from the usual

4000-series HD Graphics we usually see on other budget laptops. While this more powerful hardware doesn't make a huge difference when playing modern games – in our Dirt Showdown test it could muster only 19.4fps – it should help make the laptop a little more sprightly when playing HD videos and running very basic 3D games.

We always stress the need for a 1,920x1,080 display if you're looking to multitask with windows side by side, but unsurprisingly that's out of reach for budget machines such as the Aspire V3-371. We can forgive the 1,368x768 resolution, but we can't say the same of the panel's viewing angles. There's a narrow range in which the screen is legible, with dramatic contrast shifts away from this sweet spot.

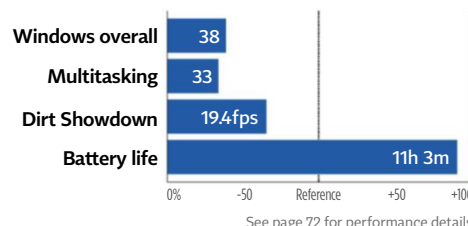
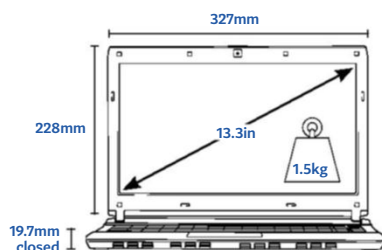
Colour performance, meanwhile, is average for a laptop at this price. In our tests the screen was able to display 65.1 per cent of the sRGB colour gamut. We would also have liked a slightly higher contrast, as 235:1 is a disappointing score. High-quality images and video certainly lose some clarity, particularly in darker scenes.

The Acer Aspire V3-371 is a decent budget laptop with a reasonable processor and great battery life. Our main gripe is with the screen; we can forgive its low resolution but the poor viewing angles and contrast make it worse than other budget laptops. If you're willing to spend £250 more, the Dell Inspiron 13 7000 (Group test, *Shopper 323*) is a more powerful 13in laptop with a Full HD screen.

*Michael Passingham*

## SPECIFICATIONS

**PROCESSOR** Dual-core 2GHz Intel Core i3-4158U  
**RAM** 4GB  
**SIZE** 327x228x19.7mm  
**WEIGHT** 1.5kg  
**SCREEN SIZE** 13.3in  
**SCREEN RESOLUTION** 1,368x768  
**GRAPHICS ADAPTOR** Intel Iris Pro 5100  
**TOTAL STORAGE** 500GB SSHD (8GB SSD cache)  
**OPERATING SYSTEM** Windows 8.1  
**WARRANTY** One year RTB  
**DETAILS** [www.acer.co.uk](http://www.acer.co.uk)  
**PART NUMBER** NX.MPFEK.052



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## POCKETABLE PC

# ZOTAC ZBox PI320 pico

★★★★☆

£194 inc VAT • From [www.amazon.co.uk](http://www.amazon.co.uk)

## VERDICT

A tiny mini-PC with performance comparable to many Windows 8.1 tablets

**THE ZOTAC ZBOX** PI320 pico is a seriously tiny mini-PC. Measuring just 19.2x66x115.5mm, it's smaller than some portable hard disks – which is no mean feat considering it's a full Windows 8.1 PC. It's actually small enough to fit into a pocket, but you'll need to take the compact power brick with you.

Built from glossy plastic with a silver outer edge, the PI320 feels well built with no hint of cut corners in terms of construction. The illuminated logo and blue ring on the top are carried over from Zotac's other systems, but it's possible to turn these off in the BIOS should you find them distracting.

The PI320 is so compact it can be bolted on to the back of a monitor using the included VESA-compatible mounting bracket. This will work with most monitors, apart from a few that already use the VESA mounting points for their stands.

Zotac hasn't tried to make the chassis as thin as possible, instead leaving room for **connectivity**, which is often lacking on other compact systems. There are two USB ports on the side and one on the back, although none is the faster USB3 type, as well as a single HDMI video output. It's a shame the Ethernet port is only rated for 10/100Mbit/s speeds rather than Gigabit. You do get 802.11n Wi-Fi, along with Bluetooth 4.0 for connecting a wireless mouse and keyboard.

## COOL RUNNINGS

The PI320 is passively cooled, so there are no noisy fans inside to cool the 1.33GHz Intel Atom Z3735F processor. The CPU can Turbo Boost to 1.83GHz when thermal limits allow, making the chassis ever so slightly warm to the touch after prolonged use.

This is essentially the same processor seen in cheap Windows 8.1 tablets such as the Linx 7 (see reviews, *Shopper 324*), and it's a similar story with the 32GB of MMC storage. It has the edge in terms of RAM though, with 2GB instead of the paltry 1GB found in many tablets. That's not a huge amount of memory for a desktop PC, however, and there's no way of upgrading. Unlike many of Zotac's other systems, the PI320 isn't sold as a barebones kit.

Performance in our desktop application benchmarks was as expected, with an overall score of 19. Testing browser performance using the SunSpider browser



benchmark resulted in a score of 525ms. The PI320 will

be able to cope with web browsing, document editing and other basic desktop tasks, which could make it a great choice for an office PC.

It also coped with HD video content, so the PI320 should fit the bill if you're looking for a discrete system to use as an HTPC. With Windows 8.1 installed you're left with just 20GB of free space, so you'll certainly want to add some external storage if you plan on storing your video and music libraries **locally**, but thankfully the built-in memory card reader supports microSD, microSDHC and microSDXC cards for quickly adding extra **capacity**.

## JITTER BUG

Don't expect the PI320 to cope with any strenuous gaming, however. It could manage only 14fps in *Dirt Showdown* with graphics quality set to Low and anti-aliasing disabled, which neither looked good nor was smooth enough to be considered playable. Certain games from the Windows Store didn't fare any better, either. *Sonic Dash*, which can be played with keyboard or mouse controls, had a very jittery frame rate that didn't make for an enjoyable experience. *Halo: Spartan Assault* was actually playable, so some gaming is possible, but your options will be limited.

Zotac should be commended for compressing a full Windows 8.1 system into such a tiny and attractive package, but the ZBox PI320 pico is essentially no more powerful than a budget Windows tablet. Its portability is useful until you consider the need to carry the power supply and potentially a keyboard and mouse.

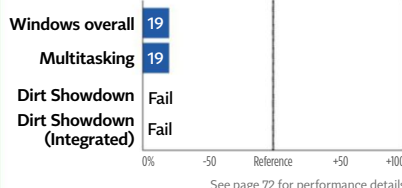
While connectivity on tablets such as the Linx 7 is distinctly lacking compared to the PI320, you do get the added benefit of having a battery-powered device that works anywhere. A USB OTG cable and a powered USB hub will get around most connectivity limitations.

At just £80 the Linx 7 is an absolute bargain and would be our preference for a low-cost Windows 8.1 system unless you have a specific preference for a compact PC system. It also means the Zotac ZBox PI320 pico is slightly pricy for what is on offer, as good looking as it is.

Richard Easton

## SPECIFICATIONS

**PROCESSOR** Quad-core 1.33GHz Intel Atom Z3735F  
**RAM** 2GB  
**FRONT USB PORTS** 2x USB  
**REAR USB PORTS** 1x USB  
**TOTAL STORAGE** 32GB MMC  
**GRAPHICS CARD** Intel Integrated Graphics  
**DISPLAY** None  
**OPERATING SYSTEM** Windows 8.1 with Bing  
**WARRANTY** Two years RTB (three years with registration)  
**DETAILS** [www.zotac.com](http://www.zotac.com)  
**PART CODE** ZBOX-PI320-W2



## YOYOTECH BlackBox DB3

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## VERDICT

The BlackBox DB3 is a well-equipped and powerful gaming system, but it's not cheap

**IF YOU LIKE** your PC components to be on permanent display, YoyoTech's BlackBox DB3 goes one better than a mere window; its Corsair Graphite 760T case has a transparent side panel, showing off everything inside.

Both side panels are hinged from the rear and open with tool-free latches. You'll need some clearance on either side of the desktop to open the doors, but once open it's possible to lift each one completely off its hinges.

There's plenty of cooling, with two 140mm LED fans at the front and two non-illuminated 140mm fans on the top. The case stands on two raised feet, which creates plenty of clearance underneath for better airflow. CPU cooling comes in the form of a Corsair H80i Hydro Series liquid cooler that uses a 120mm fan mounted to the rear of the case.

## FAN ZONE

A fan controller on the front toggles between silent and performance fan modes. In performance mode the BlackBox DB3 doesn't go beyond a gentle whirr, even under load, as the large fans are able to run at a lower rpm to reduce system noise. For such a powerful PC, it's impressively quiet. It's also well cabled, with everything neatly routed behind the motherboard. Combined with the excellent fans, the system is incredibly well ventilated.

A 750W Seasonic Evo Bronze PSU should provide enough power for upgrades, and there's plenty of potential in the case as well. Only one of the three external 5¼in drive bays is occupied by a DVD-RW drive, there are

three free 2½in bays and five free 3½in bays, which also support 2½in disks.

An Intel Core i7-5930K has six cores running at 3.5GHz, but can Turbo Boost to 3.7GHz. This is paired with 16GB of 2,133MHz DDR4 memory, helping it achieve an overall score of 138 in our tests. The BlackBox DB3 will be more than powerful enough for most uses.

The system also comes with an MSI GeForce GTX 970 Gaming Edition graphics card with 4GB of GDDR5 RAM. The GTX 970 is a spectacular performer and made light work of Dirt Showdown, managing 124.6fps at 1,920x1,080 resolution and Ultra quality graphics.

It also managed 72.7fps in the more demanding Crysis 3 at 1,920x1,080, with 4x anti-aliasing and High quality graphics. Pushing it to Very High quality dropped the frame rate to 44.9fps, which is still perfectly playable. With 8x anti-aliasing we saw an average 31.7fps, which while not silky smooth is still just about good enough.

## SLOT MACHINE

An MSI X99S Gaming 7 motherboard provides decent upgrade potential with plenty of SATA3 ports and graphics card slots. The graphics card fills one of the four PCI-E x16 slots, although it obstructs the PCI-E x16 and PCI-E x1 slots below it. The motherboard supports up to three-way mode SLI, but with all three slots in use they operate at x8 speeds.

The motherboard can support up to a staggering 128GB of RAM in its eight memory slots. Four of the slots are already occupied. There are also eight SATA3 ports, five of which are free, and an M.2 slot for compact SSDs. There are some other nice touches for anyone looking to tinker, such as a debug LED and easy-to-access clear CMOS button on the back of the I/O panel.

Connectivity is excellent, with two USB ports, two USB3 ports and headphone and microphone jacks on the front. A further eight USB3 ports are on the back, along with another two USB ports. At the back, you get Killer Gigabit Ethernet for networking, an optical S/PDIF and 3.5mm audio jacks for up to 7.1 surround sound.



The 2TB mechanical hard disk leaves plenty of space for games and multimedia files, but we were hoping for a larger SSD than the 120GB model provided; a large proportion of that space is taken up with the Windows 8.1 operating system. The SSD speeds up boot and shutdown times, however, and games load quickly.

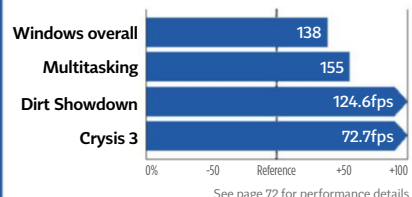
There's a lot to like about the YoyoTech BlackBox DB3, such as its wonderful case and decent motherboard. Gaming performance is nothing to scoff at, either. It's pricy, however, and for the money we would have wanted a bigger SSD. If you're not looking to spend quite as much, the Scan 3XS Z97 Performance GTX (see *Shopper 321*) produces excellent performance for around £300 less.

Richard Easton



## SPECIFICATIONS

**PROCESSOR** Six-core 3.5GHz Intel i7-5930K  
**RAM** 16GB  
**FRONT USB PORTS** 2x USB, 2x USB3  
**REAR USB PORTS** 2x USB, 8x USB3  
**TOTAL STORAGE** 120GB SSD, 2TB hard disk  
**GRAPHICS CARD** 4GB MSI GeForce GTX 970 Gaming Edition  
**DISPLAY** None  
**OPERATING SYSTEM** Windows 8.1  
**WARRANTY** Three years (One year parts and labour, two years labour RTB)  
**DETAILS** [www.yoyotech.co.uk](http://www.yoyotech.co.uk)  
**PART CODE** 1011954





## BUSINESS LAPTOP

# TOSHIBA Satellite Pro R50-B-12U



£491 inc VAT • From [www.ebuyer.com](http://www.ebuyer.com)

### VERDICT

A competent business laptop with a decent processor and battery life, but other laptops offer more for the money

**WITH WINDOWS 8** continuing to alienate businesses and their employees, many laptop manufacturers are sticking with Windows 7 on their business laptops. Windows 7 will continue to receive security updates until 2020, so you don't have to worry about being out of date for at least five years.

The Toshiba Satellite Pro R50-B-12U is a budget business laptop in a rugged-feeling chassis. It's completely black, with the lid and wrist rest coated in a corrugated plastic. It looks understated but feels well built, and there's lots of room for the full-size keyboard and touchpad. The keyboard has island-style keys, which are fairly comfortable to type on, but we would have liked a little more tactile feedback and travel. All the important keys are a good size, with the number pad slightly squashed in order to give the main keys room to breathe. The touchpad is responsive, although the physical mouse buttons have a very small amount of travel, meaning they're not particularly pleasant to click on.

### DECENT STANDARD

You get 500GB of mechanical hard disk storage. We were also happy to see that the wireless chip supports the latest 802.11ac Wi-Fi standard, which allows for faster and more reliable connections to 5GHz routers.

There's a Gigabit Ethernet port and a USB connector on the left of the impressively thin chassis, along with a DVD drive, which is a rarity on thinner laptops. On the right are two high-speed USB3 connectors and VGA and HDMI ports for connecting to an external monitor or projector.

You may want to connect to an external monitor when you're at a desk, as the Satellite Pro R50-B-12U has only a 1,366x768 resolution display, so having multiple windows open side by side is a challenge. The panel is an average performer, managing to display 65 per cent of

the sRGB colour gamut.

It's a bright screen, putting out 228cd/m<sup>2</sup> of light. Combined with a matt screen coating, it should be suitable for outdoor use, or near a window where there's lots of natural light. Contrast is a low 274:1, meaning it's not really suitable for looking at detailed or dark photographs or videos.

### RIGHT SAID THREAD

The Satellite Pro R50-B-12U uses a 1.9GHz dual-core Intel Core i5-4210U processor with hyperthreading, meaning it splits its two physical cores into four virtual ones to make better use of multithreaded applications. It can also Turbo Boost to 2.7GHz when thermal conditions allow for it. It's a competent CPU, scoring 39 for photo conversion, 45 for video editing and 44 for multitasking in our multimedia benchmarks, so it will handle basic business and productivity programs, play HD videos and load media-heavy web pages with ease. In normal usage the laptop runs quietly and remains cool; even under load, the intake fans are in no way intrusive, and the keyboard tray remains comfortably cool.

There's no dedicated graphics card in this serious business laptop, so gaming is off the table. The integrated Intel HD Graphics 4400 GPU can play older games, but it won't handle newer 3D games at decent texture and resolution settings. It managed 18fps in our Dirt Showdown benchmark at 1,280x720 and High graphics settings, although dropping it to Low increased performance to 32fps. Low settings at this resolution aren't particularly

attractive, though, so if games are a priority, you'll have to spend a little more on a laptop with a discrete graphics card.

Battery life is good, going from a full charge to empty in 6h 17m in our light usage test. While you'll want to take the lightweight charger with you if you're heading out and about, you won't find yourself worrying about the laptop shutting down if you're going off-grid for a few hours.

### GOOD VIBRATIONS

There are a few pre-installed programs, but they're not intrusive and easy to get rid of. McAfee Internet Security is pre-loaded, as is Evernote, Spotify and a long list of Toshiba-branded tools that vary in usefulness. These include an app that lets you know if your hard disk has experienced a vibration, cheerily telling you it's moved the hard disk's head to a safe position to protect it. A notification popped up every time we picked the laptop up, but these warnings are easy to turn off.

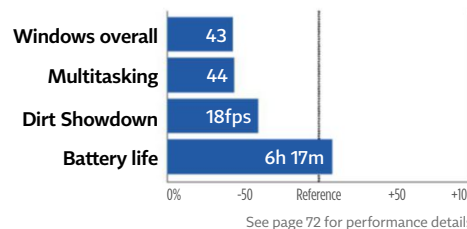
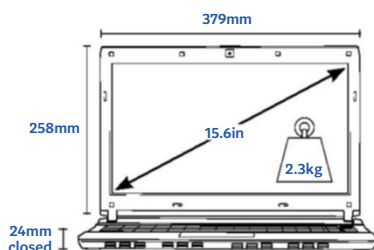
We like the Toshiba Satellite Pro R50-B-12U. It offers good performance and a sturdy build in a robust, plain chassis that doesn't stand out from the crowd. It does the basics well and, while it may not set the pulses racing, it's good enough for most basic business and home uses. If you want something a little more exciting, the Dell Inspiron 15 5000 (Group Test, *Shopper 321*) comes with an Intel Core i7 processor and a dedicated graphics card, but costs a little more.

*Michael Passingham*



## SPECIFICATIONS

**PROCESSOR** Dual-core 1.7GHz Intel Core i5-4210U  
**RAM** 4GB  
**SIZE** 379x258x24mm  
**WEIGHT** 2.3kg  
**SCREEN SIZE** 15.6in  
**SCREEN RESOLUTION** 1,366x768  
**GRAPHICS ADAPTOR** Intel HD Graphics 4400  
**TOTAL STORAGE** 500GB hard disk  
**OPERATING SYSTEM** Windows 7 Professional  
**PARTS AND LABOUR WARRANTY** One year RTB  
**DETAILS** [www.toshiba.co.uk](http://www.toshiba.co.uk)  
**PART NUMBER** PSSG0E-023002EN





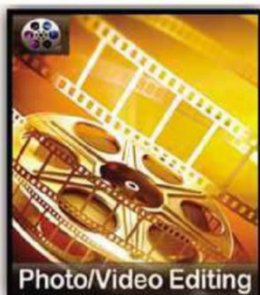
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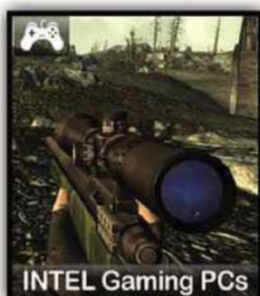
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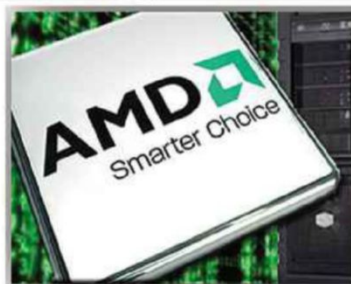
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## CURVED DISPLAY SMARTPHONE

# SAMSUNG Galaxy Note Edge



£680 inc VAT • From [www.expansys.com](http://www.expansys.com)

### VERDICT

It's expensive and the curved screen adds nothing to the phone's usefulness, but this is still a quick and decent phone

**THE GALAXY NOTE** Edge could be the most bizarre smartphone you'll see all year. It's based on Samsung's excellent Galaxy Note 4 phablet, but the screen extends over the right side of the handset. This sloping edge adds an extra 160 pixels to its 5.6in, 2,560x1,440 display.

It's an eye-catching design, but those hoping for a more pocket-friendly phablet will be disappointed; at a sizeable 151x82x8.3mm, reaching to the other side of the screen can be a bit of a stretch. At least the textured faux leather rear provides plenty of grip.

Swiping through the various side panels reveals a cut-down version of the app launcher, the day's weather, stats from Samsung's S Health app, news headlines, data usage, a Windows-esque taskbar and even a burger-stacking game, but none of them uses the curve in any meaningful way and shunting everything to one side feels cramped.

Away from the home screen you're simply presented with a black edge, which can be customised with a bit of text. It suggests that even Samsung doesn't know what to do with this strange display, and while the reflective screen surface masks the unused space rather effectively, the single handwritten font is tacky and detracts from the rest of the phone's high-end design.

### BEHIND THE CURVE

The curve makes taking pictures awkward, as the onscreen shutter button snakes round the top of the screen. Trying to reach it with our index finger felt cramped and reduced our grip. The 16-megapixel sensor has optical image stabilisation built in, but the shutter button is so uncomfortable we ended up tapping the screen to take pics.

Onscreen buttons aside,

our outdoor shots looked great, showing bright, vibrant colours even in overcast conditions. Buildings look sharper than on the Note 4, and shadows are darker and more pronounced, giving objects a bit more pop. HDR mode also produces visibly pleasing shots. However, both phones tend to smooth over detail on HDR mode. We'd recommend sticking to Auto for more detailed shots.

The only good thing about the curved edge is the night clock, which shows the time and date when the phone's in sleep mode. Screen brightness is just right, too, so it won't distract you from getting to sleep.

The curve may be a bit of a botched experiment, but that doesn't mean the Note Edge is a bad phone. The 5.6in screen is a fraction brighter than the Note 4's at 340.1cd/m<sup>2</sup>, with cleaner whites for slightly punchier visuals and more striking contrast. Text looks equally dark and defined thanks to perfect 0.00cd/m<sup>2</sup> black levels, while a pixel density of 524ppi is also higher than the Note 4's 515ppi, though the difference is barely noticeable in practice.

### KEEPING WARM

The Note Edge covers the full 100 per cent of the sRGB colour gamut, although this doesn't necessarily guarantee accurate colours; our measurement report revealed oversaturated reds and greens. Still, we prefer the extra vibrancy afforded by the warmer colours, and videos in particular look superb.

Like the Note 4, the Note Edge includes Samsung's S Pen, which slots into the bottom of the handset when not in use. With 2,048 levels of pressure sensitivity it's a great tool for drawing, although the sloping edge doesn't give quite as much grip as the Note 4's flat sides.

Multi Window, which lets you use two apps simultaneously, wasn't designed with the Note Edge's curved screen in mind. The already tiny sidebar footprint becomes even smaller here, making it difficult to swipe through the edge panels and tap icons accurately.

This is a shame, as the 2.7GHz quad-core Snapdragon 805 processor makes the Note Edge a fast and powerful phone. It scored a fast 347ms in our SunSpider JavaScript test, so will easily handle complex websites.

Graphics performance is impressive, too, maxing out 3DMark Ice Storm Extreme and scoring a huge 19,096 (or 76.1fps) in Ice Storm



Unlimited. The extra resolution didn't affect frame rates in Epic Citadel, where it managed 48.3fps on Ultra High quality settings. That's just one frame per second behind the Note 4.

### CANDLE IN THE WIND

Sadly, the Note Edge's 3,000mAh battery can't hold a candle to the Note 4, lasting just 13h 30m in our continuous video playback benchmark with the screen set to 170cd/m<sup>2</sup>. The Note 4 lasted 15h 36m under the same conditions.

Our biggest concern, however, is the price. At £680 SIM-free or £53.50 on contract with a £49 upfront cost, the Galaxy Note Edge is more expensive than Samsung's superior Note 4, and the curved screen does very little to justify the extra price hike other than its role as a glorified alarm clock. If you're looking for the best large-screen phone, the Note 4 remains our phablet of choice.

Katharine Byrne



### SPECIFICATIONS

**PROCESSOR** Quad-core 2.7GHz Qualcomm Snapdragon 805  
**SCREEN SIZE** 5.6in  
**SCREEN RESOLUTION** 2,560x1,600  
**REAR CAMERA** 16 megapixels  
**STORAGE** 32GB/64GB  
**WIRELESS DATA** 4G  
**SIZE** 151x82x8.3mm  
**WEIGHT** 174g  
**OPERATING SYSTEM** Android 4.4  
**WARRANTY** One year RTB  
**DETAILS** [www.samsung.com/uk](http://www.samsung.com/uk)  
**PART CODE** SM-N915G



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## MICROSOFT Lumia 535



£90 inc VAT • From [www.argos.co.uk](http://www.argos.co.uk)

## VERDICT

The Microsoft Lumia 535 retains the same great build quality as Nokia Lumias, but its poor battery life and unresponsive touchscreen makes it frustrating to use

**ONE OF THE** best things about Nokia's Lumia phones was how well each one handled the Windows Phone 8.1 operating system. The budget handsets were particularly impressive, as even the £90 Lumia 530 with its 512MB of RAM felt smoother and more responsive than many similarly priced Android phones. Sadly, the first Lumia phone to arrive without Nokia branding brings this legacy to a grinding halt.

On paper, the Lumia 535 should be faster than the smaller Lumia 530, as it now has 1GB of RAM accompanying its 1.2GHz quad-core Qualcomm Snapdragon 200 processor. This seemed to be the case in our web-browsing test, with the Lumia 535 finishing in 1,258ms compared to the Lumia 530's 1,453ms.

## SYSTEM FAILURE

In practice, though, Microsoft seems to have broken its own operating system, as the Lumia 535 is not only noticeably jerky when swiping between menus, but also regularly failed to register taps while typing and using the onscreen menu buttons. Even worse, we found pinching-to-zoom while web browsing nigh on impossible, as the phone nearly always selected a link instead or made the whole page wobble as it decided whether to

0.44cd/m<sup>2</sup> means that text and the black background look grey compared to the phone's jet black bezels. Text is still legible, thanks in part to the decent contrast ratio of 960:1, but the tiny 960x540 resolution means desktop sites are a strain on the eyes.

The Lumia 535 has a fairly accurate screen, with our colour calibrator showing it was displaying 83.5 per cent of the sRGB colour gamut. This isn't fantastic, as we now regularly see at least 90 per cent from budget Android phones, but it's at least in keeping with the Lumia 630 and surpasses the Lumia 530's 67.1 per cent.

The Lumia 535 has all the latest Windows Phone 8.1 features, including Cortana, Microsoft's personal digital assistant that can search the web to answer queries via voice control.

Cortana's main strength is creating reminders. You'll have to be careful in how you phrase reminders and appointments, though, as Cortana didn't pick up conflicts between reminders and calendar appointments.

Other requests result in general Bing searches as well, which only search for the terms you posed in the question. For example,

## Microsoft seems to have broken its own operating system, as the Lumia 535 is jerky when swiping between menus

scroll or zoom. It's the first Windows Phone we've ever found truly frustrating to use.

Battery life is equally terrible. In our video test, the 1,905mAh battery lasted just 7h 10m with screen brightness set to medium. That's the worst score we've seen from a Lumia phone this year. Admittedly, the Lumia 530 only lasted another 75 minutes under the same conditions, and that has a much smaller screen eating up less power, but if the £100 Lumia 630's 1,830mAh battery can manage just over 12 hours, we'd expect the Lumia 535 to last at least around 10 hours.

That said, the Lumia 535's 5in 960x540 display is much brighter than most Lumia phones, bar the 830. With a peak brightness of 427.69cd/m<sup>2</sup>, this will draw more power regardless of which of the phone's three brightness profiles you choose, but at least it means the phone is easy to use outside.

A high brightness level causes washed-out blacks, too. Our black level measurement of

when we asked Cortana, "What's the latest celebrity news?" it only turned up broad hub pages for 'celebrity news'. Apple's Siri, on the other hand, found specific stories about individual celebrities that looked far more interesting to read. As with previous Lumia handsets we've tested with Cortana, there's still a long way to go before it can rival Siri in terms of accuracy and efficiency.

## SOFT FOCUS

The Lumia 535 has 5-megapixel cameras on both the front and back of the phone, but we weren't very impressed with the overall picture quality. Our outdoors shots were reasonably well exposed, with rich, accurate colours, but particularly light or bright areas seemed to bleed out into the surrounding picture, making certain areas appear slightly soft and hazy. We found this rather off-putting as it removed a lot of the detail on show and gave everything a noticeable white



and yellowish sheen. Objects and buildings further away also weren't particularly crisp round the edges, but this isn't surprising for a 5-megapixel camera.

We're not sure how Microsoft's gone so wrong with the Lumia 535, but it remains one of the worst Windows phones we've ever tested. This is a shame, as it's just as well built as other Lumia phones and its funky set of colours offer a great alternative to the swathe of budget black-and-white Android phones available. If you're set on getting a cheap Windows phone, the Lumia 630 is a much better buy than this poor effort, as it's not only much quicker and easier to use, but it also has a much longer-lasting battery.

Katharine Byrne

## SPECIFICATIONS

**PROCESSOR** Quad-core 1.2GHz Qualcomm Snapdragon 200  
**SCREEN SIZE** 5in  
**SCREEN RESOLUTION** 960x540  
**REAR CAMERA** 5 megapixels  
**STORAGE** 8GB  
**WIRELESS DATA** 3G  
**SIZE** 140x72x8.8mm  
**WEIGHT** 146g  
**OPERATING SYSTEM** Windows Phone 8.1  
**WARRANTY** One year RTB  
**DETAILS** [www.microsoft.com](http://www.microsoft.com)  
**PART CODE** RM-1090



## DUAL-SCREEN ANDROID PHONE

# YOTA Yotaphone 2



£555 inc VAT • From [www.yotaphone.com](http://www.yotaphone.com)

### VERDICT

The Yotaphone 2 is full of great ideas and its rear E-Ink display gives it a potentially huge battery life, but it won't replace your eReader

**THE FIRST YOTAPHONE** was a phone like no other. It looked like an ordinary Android handset from the front, but at the back an always-on E-Ink display kept you up to date with notifications without draining power. Sadly, the lack of touch support made it frustrating to use. However, its **successor**, the Yotaphone 2, is everything the first handset should have been and more.

You can now mirror Android 4.4 on the back of the handset. This means you can make calls, send texts, use social media and do everything you'd normally do on your phone from the E-Ink screen. The rear screen now has full touch support, addressing our main complaint with the original.

This has huge implications for battery life, as E-Ink displays consume much less energy than LCD screens. The front screen uses an AMOLED panel, which is slightly more energy-efficient than LCD, but the E-Ink screen will last for five days on a single charge of the 2,500mAh battery.

### DAY OF RECKONING

You should still be able to get a day's use out of the Yotaphone 2 as an ordinary handset; it managed 10h 42m in our video playback test with the front screen's brightness set to 170cd/m<sup>2</sup>, although admittedly that's not the best battery score we've seen recently.

The E-Ink screen took a full 24 hours to drain to 50 per cent, over a weekend of using the front screen to take pictures and browse the web, and periodically checking the rear screen for time and weather updates.

The E-Ink screen isn't just a battery-saving exercise, though. We liked being able to put the phone face-down on a table and still see the time, notifications and upcoming calendar appointments just by glancing down at the screen.

The E-Ink display's slower sample rate means it doesn't feel as quick as an LCD screen, but it still takes only about a second for the page to fully refresh. You don't need to worry about accidentally tapping other panels when you switch to the front screen, as the Yotaphone 2 automatically

locks the rear screen as soon as you turn it over. Corning Gorilla Glass 3 protects both displays to help minimise accidental damage.

The native YotaReader app only supports DRM-free eBooks, so Kindle users will be disappointed, but you can mirror the Kindle app from the front screen if most of your library is tied to Amazon. However, the front screen's 5in 1,920x1,080 resolution is much higher than the rear screen's 4.7in 960x540, so fonts in the mirrored Kindle app don't scale as well as those in YotaReader. Not that you get much choice in the matter, as YotaReader has only two different fonts to choose from.

Our biggest complaint concerns the E-Ink screen's poor contrast, which makes text look grey and sketchy, making it difficult to read. YotaReader needs a lot more work before it becomes a viable competitor to dedicated eReaders such as Amazon's Kindle.

### POPULAR FRONT

We don't have any complaints about the front screen, though, as the 5in Full HD AMOLED panel looks gorgeous. As we'd expect from an AMOLED display, it displays a full 100 per cent of the sRGB colour gamut, so colours are rich and vivid, and its black levels are a perfect 0.00cd/m<sup>2</sup>. The screen's contrast levels were also off the charts, providing the phone with excellent viewing angles and plenty of detail in our high-contrast test images. Brightness is a little low at 268.93cd/m<sup>2</sup>, but we found this was still bright enough to use outside.

Performance is also right up there with the best smartphones. The 2.2GHz quad-core Snapdragon 800 processor might not be Qualcomm's latest high-end chipset, but it's still a powerful CPU. Web browsing is beautifully smooth, and we saw no signs of judder. The stock version of Android 4.4 zips along nicely, making the Yotaphone 2 just as responsive as phones with more recent chipsets.

Graphics performance is equally impressive, with a huge score of 15,592 (or 63.9fps) in Ice Storm Unlimited. Moreover, the Yotaphone 2 managed 52.9fps on Ultra High



quality settings in Epic Citadel, so it shouldn't have any trouble handling the latest games.

The rear 8-megapixel camera produces decent images, but overexposed the sky quite heavily in our outdoor shots. There's plenty of detail on **show**, and colours look rich and natural, if a little dull. However, we wouldn't recommend using the camera's HDR mode, as sections of cloud became solid grey.

The Yotaphone 2 has its shortcomings, but it's still a huge improvement on its predecessor, with plenty of useful features. At £555 SIM-free, it's very expensive, but this is to be expected given the fact that it has two screens. However, there's more work to be done before it achieves its full potential, as the E-Ink screen isn't quite good enough to replace a dedicated eReader.

Katharine Byrne



### SPECIFICATIONS

**PROCESSOR** Quad-core 2.2GHz Qualcomm Snapdragon 800  
**SCREEN SIZE** 5in (front), 4.7in (rear)  
**SCREEN RESOLUTION** 1,920x1,080 (front), 960x540 (rear)  
**REAR CAMERA** 8 megapixels  
**STORAGE** 32GB  
**WIRELESS DATA** 4G  
**SIZE** 145x69x8.95mm  
**WEIGHT** 145g  
**OPERATING SYSTEM** Android 4.4.4  
**WARRANTY** One year RTB  
**DETAILS** [www.yotaphone.com](http://www.yotaphone.com)  
**PART CODE** Yotaphone 2





# SONY Alpha A77 II



£930 inc VAT (price, specs and rating based on body-only package) • From [www.jessops.com](http://www.jessops.com)

## VERDICT

Fast and feature-packed, the Sony Alpha A77 II delivers for image quality too

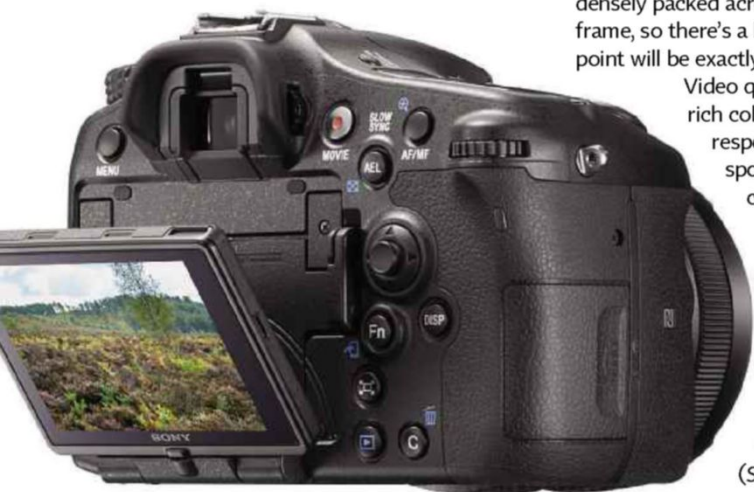
**THE ALPHA A77 II** looks like an SLR, but instead of a flip-up mirror that gives single-lens reflex (SLR) cameras their name, it uses single-lens translucent (SLT) technology with a fixed, translucent mirror that directs light to both the main imaging sensor and the autofocus sensor simultaneously.

The fixed mirror boosts performance, with a 12fps continuous shooting speed that's roughly double the A77 II's main competitors, the Nikon D7100 (*Shopper 308*) and Canon EOS 70D (*Shopper 311*). However, 12fps is only available in a dedicated scene preset that lacks direct shutter speed and aperture control. In program, priority and manual exposure modes, we measured continuous shooting at 8fps – still an excellent result, especially with autofocus active. Both modes lasted for around 55 JPEGs or 27 Raw frames before slowing to around 1.5fps.

## POINTS OF VIEW

The electronic viewfinder might take some getting used to, but the 24-million dot OLED is pin sharp and just as big as upmarket SLRs' optical viewfinders. There's a slight lag in low light, but the ability to preview exposure and white balance settings, magnify for manual focus adjustment and see useful information such as a histogram makes up for it.

Shooting with the LCD screen is just as responsive as with the viewfinder, which may be the clincher for people who cut their teeth on digital compact cameras and use the LCD screen as much as the viewfinder. The 3in screen is sharp and triply articulated to face virtually any direction, adding to its appeal.



One downside of the electronic viewfinder is that the imaging sensor is constantly active, taking a toll on battery life. Expect 480 shots per charge – less than half that of rival SLRs.

Nearly all these traits are shared with the original Sony A77 (see *Shopper 289*). The only exception is that the A77's burst mode slowed after 14 frames, whereas the A77 II's bigger buffer kept it going for much longer.

The physical design is virtually identical, so the magnesium alloy body is comfortable and littered with buttons. The passive LCD screen on the top plate relays settings, although with the informative viewfinder and LCD screen, we didn't glance at it often.

## WITHIN RANGE

One small difference is that the Help button is now customisable, defaulting to an Autofocus Range Control mode. Pressing it and rotating the command dials limits the focusing distance, which is great for avoiding accidentally focusing on the background or foreground.

There's the same generous allocation of sockets, with USB, HDMI, microphone, wired remote, flash sync and DC in. GPS has disappeared, but Wi-Fi has been added; we would have preferred both.

The 19-point autofocus sensor has been upgraded to 79 points, 15 of which are cross-type for increased sensitivity. They're densely packed across a large area of the frame, so there's a high chance an autofocus point will be exactly where you want it.

Video quality is excellent, with rich colours, sharp details and responsive autofocus. We spotted occasional compression artefacts in AVCHD footage, though. It's disappointing the camera doesn't support the XAVC S format that Sony is increasingly using in its upmarket cameras, and video details weren't as fine as from the Sony RX100 M3 (*Shopper 322*), but they were

much better than from the Canon EOS 70D.

Noise levels are also restrained, with excellent video quality at ISO 3200.

Photo quality is fantastic. The 24-megapixel sensor captures lots of detail, and the JPEG engine squeezes every last drop out of the Raw image data. If anything, sharpening is too strong, revealing aliasing artefacts on fine details in our studio scene, but we rarely spotted this in real-world shots.

The A77 II shows a vast improvement over the A77 in terms of noise. ISO 12800 Raw files are a little noisier than the Canon 70D and Nikon D7100, but JPEGs were harder to separate. The noise-reduction struggled with out-of-focus areas of the frame, though, resulting in some strange blotchy patterns.

## THE GREAT AND THE GOOD

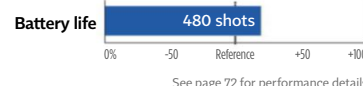
There's much to admire in the A77 II, but at this price that's hardly surprising. There's no shortage of outstanding cameras for around £1,000 (body only), not just in SLRs but also in premium CSCs such as the Fujifilm X-T1 and Panasonic GH4 (see *Shopper 316* and *318*).

The A77 II won't be everyone's first choice, but it carves a niche with its combination of substantial SLR-like ergonomics, fast continuous performance and the ability to move effortlessly between viewfinder and LCD screen operation.

Ben Pitt

## SPECIFICATIONS

**SENSOR RESOLUTION** 24 megapixels  
**SENSOR SIZE** 23.5x15.6mm (APS-C)  
**FOCAL LENGTH MULTIPLIER** 1.5x  
**VIEWFINDER** Electronic (2.4 million dots)  
**LCD SCREEN** 3in (1,228,800 dots)  
**LENS MOUNT** Sony Alpha  
**WEIGHT** 728g  
**DIMENSIONS** 105x149x85mm  
**WARRANTY** One year RTB  
**DETAILS** [www.sony.co.uk](http://www.sony.co.uk)



## PREMIUM DSLR CAMERA

# CANON EOS 7D Mark II



£1,599 inc VAT (price, specs and rating based on body-only package) • From [www.jessops.com](http://www.jessops.com)

### VERDICT

Fast and feature-packed, but the Canon EOS 7D Mark II isn't the showstopper we'd hoped for

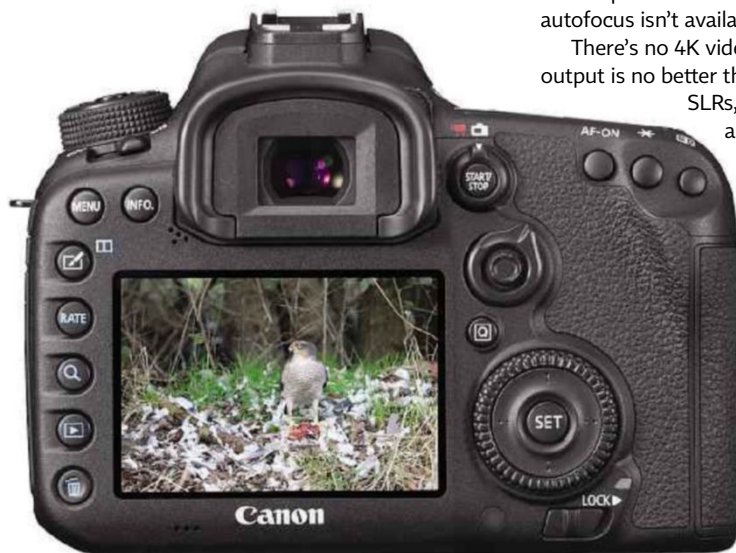
**THE EOS 7D** Mark II is designed for blistering performance. Externally, it's very similar to the original EOS 7D, with lots of top-tier features including a weather-sealed magnesium alloy body, CompactFlash and SDXC card slots.

GPS is built in for geo-tagging of photos, and interval shooting is included for the first time on a Canon SLR, capturing shots at regular intervals for turning into time-lapse videos. The 670-shot battery life is **poor**, though; we'd expect nearer 1,000 at this price.

Buttons along the top assign the command dial and rear wheel to metering, drive and autofocus modes, white balance, ISO speed and flash compensation. These are easy to operate without moving the camera away from your eye, with settings overlaid across the viewfinder. A mini-joystick moves the autofocus point and a small lever cycles through the various expanded autofocus areas, with a choice of one, five, nine, 15, 25 or all 65 points. These points are cross type, which means each one is actually two sensors placed at right angles for increased **sensitivity**.

### POINT TO PROVE

Having 65 autofocus points covering a large area of the frame makes it easy to focus on small subjects. It took only between 0.1 and 0.4 seconds from pressing the shutter button to capturing a shot with USM lenses. The AF-On button can assign autofocus and shutter release to separate buttons, so you can choose when to refocus on subjects and when to shoot without any discernible lag.



The fastest continuous mode delivers speeds between 9 and 10fps, with updated autofocus for moving subjects barely affecting performance. It kept this speed up indefinitely when shooting JPEGs to a fast SDHC card, and slowed to 1.9fps after 19 Raw frames.

Tracking moving subjects around the frame isn't as responsive or reliable as Nikon's similar 3D Tracking system. By default the 7D Mark II can't define which autofocus point to use as a starting point, instead picking the nearest subject or any detected faces.

Dual-pixel technology makes autofocus in live view mode a viable option, though it still takes between a half and one second to focus and capture a shot. The screen was blank for a second after shooting, and could muster a photo only every 2.1 seconds in live view mode.

### VIDEO STAR

Dual pixel also brings smooth autofocus to video capture. It worked brilliantly in our tests, responding decisively to moving subjects with no unwanted focus hunting. However, the lack of a touchscreen means moving the autofocus point while recording is quite cumbersome.

Using an external microphone prevents lens noise, and it's great to see a headphone socket for live monitoring. We'd like it more if it could show an adjustable volume meter.

Video recording is at 1080p at up to 60fps, **double previous Canon SLRs**, but continuous autofocus isn't available beyond 30fps.

There's no 4K video function, and 1080p output is no better than other recent Canon SLRs, with a slightly coarse appearance to details.

There are no focus peaking or zebra modes to help with manual focus and exposure adjustment, and the lack of an articulated screen is another setback for video work.

The EOS 7D Mark II's 20-megapixel sensor has identical specifications to the EOS 70D's sensor, so it's no surprise they're virtually neck and



neck for detail, dynamic range and noise levels. The EOS 7D Mark II exhibits less chroma noise in JPEGs at high ISO speeds, though.

### MEAGRE PICKINGS

The meagre improvement in image quality compared to the five-year-old EOS 7D might come as a surprise to potential upgraders. The move from 18 to 20 megapixels is insignificant, and improvements to JPEG and Raw noise levels are modest. The maximum ISO speed has increased from 12800 to 51200, but as usual for a cropped-sensor camera, ISO 6400 is probably a sensible maximum.

Its closest competitor, the Nikon D7100 (see Reviews, *Shopper 308*), has a small but tangible advantage for detail levels with its 24-megapixel sensor. We were able to extract more detail from the darker recesses of its Raw output at ISO 100. Comparing their high-ISO output, the Canon's JPEGs exhibit less noise in smooth gradients, but the Nikon compensates with better detail retention.

Compared to the original 7D, the Mark II has a better autofocus sensor, is faster in live view mode, has GPS, interval shooting and various video-related upgrades, but photo and video quality haven't improved significantly.

If you aren't committed to Canon, it's hard to justify spending this much when the similar Nikon D7100 costs just £750.

Ben Pitt

### SPECIFICATIONS

**SENSOR RESOLUTION** 20.2 megapixels  
**SENSOR SIZE** 22.4x15mm (APS-C)  
**FOCAL LENGTH MULTIPLIER** 1.6x  
**VIEWFINDER** Optical TTL  
**LCD SCREEN** 3in (1,040,000 dots)  
**LENS MOUNT** Canon EF/EF-S  
**WEIGHT** 910g  
**DIMENSIONS** 112x149x78mm  
**WARRANTY** One year RTB  
**DETAILS** [www.canon.co.uk](http://www.canon.co.uk)





## HIGH-END 4K MONITOR

# ASUS PB279Q

COMPUTER  
SHOPPER  
BEST BUY



£617 inc VAT • From [www.ballicom.co.uk](http://www.ballicom.co.uk)

### VERDICT

Serving up gorgeous 4K images, the Asus PB279Q is perfect for colour-sensitive designers, photographers and gamers

**WE'VE BEEN NAVIGATING** through a deluge of cheap 4K monitors in recent months, as manufacturers attempt to wow consumers with sub-£550 monitors with 3,840x2,160 resolutions. However, the twisted-nematic (TN) panel technology they use simply can't do stunning high-resolution images, videos and games justice. The Asus PB279Q is one of the first of a new generation of 4K monitors to come equipped with a 27in AHVA panel, which on paper should mean superior image quality.

AHVA stands for Advanced Hyper-Viewing Angle and should not be confused with VA technology; AHVA is more akin to IPS, but with slightly different viewing angle characteristics and lower manufacturing costs, even though the £617 PB279Q is hardly

that the human eye can't tell the difference. Reds were the only exception, which our software detected as slightly oversaturated, but otherwise the PB279Q has well-balanced colours that make it suitable for graphic designers and photographers who need accurate colours.

Contrast levels were measured at 1,063:1, with black levels at 0.25cd/m<sup>2</sup>. While this doesn't match some of the incredible contrast and black levels of which VA screens are capable, they're still superior to TN screens, which tend to mask a little detail when confronted with images containing darker shades.



## Colours pop out of the screen, while the high resolution does justice to high-quality 4K video content

what we would call cheap. Asus says it will deliver high colour accuracy and 1,000:1 contrast ratios, as well as quick response times for delay-free work and gaming.

### POP STAR

First impressions are great. Colours pop out of the screen, while the resolution does justice to high-quality 4K video content. What's more, black levels and contrast levels are low enough to make even the darkest scenes appear rich and deep.

No calibration is required if you're looking for peak sRGB colour performance; in our tests, the panel was already displaying the full 100 per cent of the gamut at default settings.

With 10-bit colour processing allowing for 1.07bn colours, the panel is also very accurate, producing an average delta E of 1.18.

Delta E figures represent the difference between a perfect colour and the colour displayed onscreen, and smaller numbers are better. An average delta E of 1.18 is a strong score, with most colours so accurate

Viewing angles are fairly wide and are rated at 178° horizontal and vertical, although there's a blue tint when the screen is viewed from angles greater than 30° horizontally, and some moderate contrast shifting from slightly more extreme vertical viewpoints.

### PLAIN AND SIMPLE

The PB279Q has a very plain design, with a matt black bezel and stand. It's not ugly, but it's no match for some of the design triumphs Samsung has been producing recently. The stand is height adjustable and can also be rotated using a turntable under the base.

There are plenty of inputs, including DisplayPort, Mini DisplayPort and four HDMI ports. You should only use the DisplayPort connectors as your primary inputs, though, as this monitor only supports smooth 60Hz refresh rates from these ports at 3,840x2,160 resolutions. The HDMI connectors are limited to a jerky 30Hz for 4K content, which is a shame. There's no USB hub, either, which may be a problem for users who like to have a desk clear of unnecessary cables.

The extra desktop space afforded by the huge resolution is immediately obvious, although Windows 8 doesn't always handle window scaling particularly well. You'll need to make sure your software is compatible with high-DPI displays before buying, otherwise you may find yourself straining your eyes. Apple devices running OS X tend to handle high-dpi displays extremely well, so you shouldn't have to worry if you use a Mac.

Response times are quick at 5ms, and we encountered no input lag whatsoever, which can sometimes be a problem with high-resolution screens. This makes this monitor suitable for gamers. We wouldn't recommend using the built-in pair of 2W speakers for gaming, however, as they're simply not powerful enough to do your games justice.

Picture-in-picture and picture-by-picture modes are available through the onscreen menus, letting you display up to four inputs simultaneously. If you have only two or three active inputs you get lots of wasted black space, but it works well with four. Samsung monitors get round this by changing the input resolution, telling connected devices to change the aspect ratio so there's no wasted space.

The Asus PB279Q is a superb 4K monitor that combines superb image quality and a comparatively low price. If you're looking for a slightly more cinematic experience, the price of the stunning 34in, 21:9 aspect ratio LG 34UM95 (Reviews, Shopper 321) has dropped to £660, making it an equally good buy.

*Michael Passingham*

### SPECIFICATIONS

SCREEN SIZE 27in

RESOLUTION 3,840x2,160

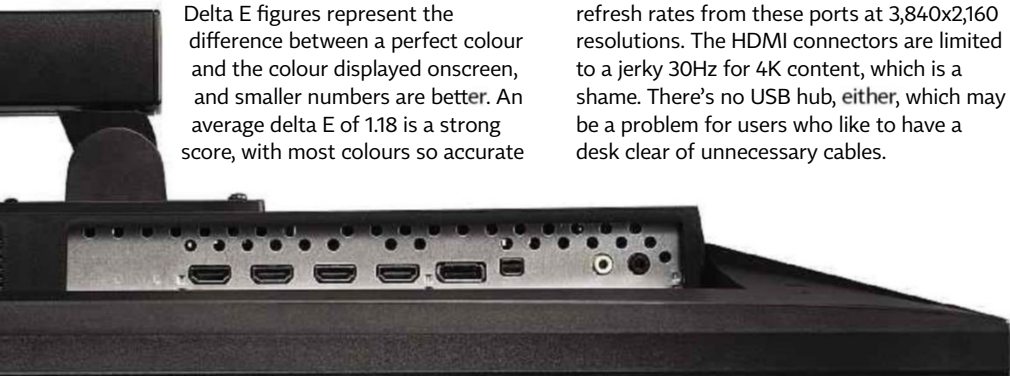
SCREEN TECHNOLOGY AHVA

REFRESH RATE 60Hz

VIDEO INPUTS 4xHDMI, DisplayPort, Mini DisplayPort

WARRANTY Three years RTB

DETAILS [www.asus.com/uk](http://www.asus.com/uk)





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## GAMING MONITOR

# EIZO Foris FS2434

COMPUTER  
SHOPPER



RECOMMENDED

£252 inc VAT • From [www.pcbuyit.co.uk](http://www.pcbuyit.co.uk)

### VERDICT

A superbly built gaming monitor with tiny bezels and great image quality – perfect for multi-monitor setups

**GAMING MONITORS TYPICALLY** come in two flavours: high refresh rate models with low response times for twitchy gamers, and high-quality panels with more sedate users in mind. The Eizo Foris FS2434 is a 23.8in monitor that fits the latter category, although the red go-faster stripe along the bottom and the angular base make it clear this is still a monitor built with gaming in mind.

The base sits on a rotating turntable and has 60mm of height adjustment, which should suit most desks. It also has a built-in carry handle at the rear, which should suit anyone who regularly attends LAN parties.

Eizo is targeting multi-monitor users with the FS2434, as the tiny 6mm bezels on the left, right and top make it ideal for a surround setup. Put three of them side-by-side and you'll barely notice the divides between them.

### START THE IGNITION

Managing multiple monitors is easy, too, thanks to Eizo's G-Ignition software. G-Ignition is a Windows application that lets you adjust picture settings for your display without having to use the monitor's own onscreen menus. In order to use it, at least one monitor

lack of DisplayPort, a very common interface on newer graphics cards, is a real shame.

In addition to DVI and HDMI, there are the two aforementioned standard USB3 ports for connecting peripherals to your PC and three 3.5mm audio jacks. Two of these, an input and an output, are next to the USB ports and therefore hidden from view to keep your desk free of visible trailing wires. The third, another output, is built into the side of the bezel, which makes it easily accessible for quickly plugging in a pair of headphones.

## The tiny 6mm bezels on the left, right and top make the FS2434 ideal for a multi-monitor surround setup

must be plugged into your PC via the USB3 type-B connector on the left of the panel. Subsequent monitors can then be daisy-chained through the primary display via USB.

G-Ignition is simple and works well, with all the preset and colour options you normally get on the monitor itself. It lets you adjust monitors individually or as a group, so you can customise your setup to your exact liking.

The FS2434 also includes a small remote control, which makes menu navigation and source switching much easier by replacing the sometimes fiddly buttons you'll find on other screens. The only buttons on the front here are power, volume and a one-button source selector that cycles through the two HDMI ports and the DVI connector.

It would have been nice to have a few more connectors on the back; Eizo is clearly marketing this as a multimedia monitor as well as a gaming screen, so three inputs of two varieties feels a little stingy, especially for users who have lots of external devices. The

We were underwhelmed by the FS2434's built-in speakers. We had high hopes for them initially because they face the user and even have holes machined into the bezel. However, a quick blast of Jay Z and a few minutes of Wolfenstein: The New Order proved that these tweeters are cheap and tinny and should be avoided at all costs. It's a shame, and harms the FS2434's credibility as a multimedia monitor. If you want a monitor with good speakers, you should look at the four-star AOC i2473PWY (Shopper 320).

### REFRESHING CHANGE

Pure IPS displays are a rarity among gaming monitors, with the technology currently incompatible with refresh rates beyond 60Hz. Instead, expensive gaming monitors use IPS-like AHVA panels. The FS2434 uses a 23.8in standard 60Hz IPS panel for accurate colour reproduction, deep blacks and high contrast levels. In our calibration tests, the monitor was able to produce 92.8 per cent of

the sRGB colour gamut. Colour reproduction is incredibly accurate; the average Delta-E figure was recorded at 1.62, which means the difference between the 'perfect' colour and the colour displayed onscreen are virtually indistinguishable to the human eye. Contrast levels weren't quite as high as we were expecting, at 883:1, but black levels were a little higher than expected at 0.26cd/m².

Overall image quality is still great, though, meaning high-quality photographs and high-resolution video look superb. There are some alternative preset colour modes made for gaming but, as expected, they merely give games a harsh, blown-out and unpleasant quality. They make in-game objects easier to see, but we can't imagine anyone would truly enjoy an atmospheric horror or story-driven game with these settings turned on.

We stuck with the default sRGB colour settings for our testing. There were no issues with input lag or response times and we'd be confident that most gamers would be happy with its performance.

The Eizo Foris FS2434 is a pretty and keenly priced gaming monitor. While twitchy gamers will want to look elsewhere at something like the 144Hz Iiyama ProLite GB2488HSU-B1 (Shopper 318), those who want high-quality images or a multi-monitor setup can't go wrong with the Foris FS2434.

Michael Passingham



### SPECIFICATIONS

SCREEN SIZE 23.8in  
RESOLUTION 1,920x1,080  
SCREEN TECHNOLOGY IPS  
REFRESH RATE 60Hz  
VIDEO INPUTS 2x HDMI, DVI  
WARRANTY Five years RTB  
DETAILS [www.eizo.co.uk](http://www.eizo.co.uk)





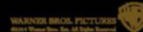
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To celebrate the release of **Jupiter Ascending** (in cinemas Feb 6), Synology is giving you the chance to win an out of this world home entertainment system including a Synology DS415play, 48" Curved LED HD 3D Smart TV, Smart 3D Blu-ray Player and soundbar speaker. For your chance to win, simply visit [www.synology.com/jupiterascending](http://www.synology.com/jupiterascending)



## JOHN LEWIS

55JL9000

£899 inc VAT • From [www.johnlewis.com](http://www.johnlewis.com)

## VERDICT

Decent picture quality and Smart TV apps, but the integrated soundbar isn't great

**THE JL9000 ISN'T** your average TV. Not only is this LG-made set branded with a John Lewis logo and sold exclusively through John Lewis shops, it has a soundbar built into the stand.

We tested the 55in 55JL9000, but the JL9000 is also available with 49in (49JL9000) and 60in (60JL9000) screens. All models have identical specifications except for dimensions and power usage, so image quality should be practically identical across the range.

The soundbar makes a nice change from downward or rear-firing speakers on other TVs, but you'll need a wide stand to place the TV on as the soundbar runs the full length of the set. This is quite cumbersome on the 55in model, but becomes even more of a problem on the 60in model. You can't wall-mount this TV, either, so it may not suit every AV setup.

Bass receives most of the benefit from the soundbar. Treble and higher frequencies are quite tinny, though, resulting in a soundscape that isn't much better than most built-in TV speakers. It certainly can't compete with a dedicated soundbar setup, but this is unsurprising given its lack of subwoofer.

## CALIBRATE GOOD TIMES

Picture quality was good out of the box, with our colour calibrator measuring 91.8 per cent of the sRGB colour gamut. This isn't quite as high as LG's slightly cheaper LB730V range, but we managed to increase this once we'd switched to Cinema mode and calibrated the TV. By changing the white balance to 20 points, the colour temperature to Warm 2, and the blue and green settings to +2, leaving red at 0, the JL9000's colour gamut coverage rose to a much more impressive 99.1 per cent.

Black levels were less impressive. Despite measuring 0.12cd/m<sup>2</sup>, night scenes in our test footage had a distinct blue tinge, including letterboxes surrounding the main picture. It got worse the further we moved from sitting directly in front of the TV, with viewing angles quickly diminishing.

This is a shame, as we hoped our measured contrast ratio of 1,342:1 would prevent the screen darkening so quickly. We could still see a high level of detail in darker scenes, but this was marred by the blue permeating through the blacks. We improved this slightly by



changing the LED Local Dimming setting to High, which made blacks appear much deeper, but this can't help with viewing angles.

As well as basic backlight, contrast, brightness, sharpness, colour and tint settings, there are also gamma options, super resolution and dynamic contrast settings, and LG's TruMotion frame interpolation.

TruMotion adds artificial frames to video content, making it appear smoother than the source material. There are lots of settings to choose from, but Clear was the most balanced, avoiding the 'soap opera effect' while still looking natural and avoiding screen-tearing. We also like the customisable User setting, where you can set de-blur and de-judder effects. Changing each effect to 3 was the most effective, as this helped fast camera pans look more controlled and less jerky.

## STANDARD PRACTICE

On standard-definition TV channels, we had to set both of the JL9000's noise-reduction settings to High to get a reasonable picture. TV looks overly smooth as a result, but it at least helps disguise most of the jagged edges. We could still see a few patches of noise in camera pans, but largely static shots looked better than on many other TVs we've seen.

HD channels looked much better from the outset, and we didn't need noise reduction at all. Text was a fraction crisper, but even setting both options to High made little difference, so we left it off for the rest of our testing.

One of the four HDMI inputs on the back is ARC compatible, with a second supporting MHL. Other connectivity is generous too, with component and composite inputs, three USB ports, an Ethernet port, optical S/PDIF audio, a CI

slot and a 3.5mm audio jack. Built-in wireless makes it easier to get online, while a pop-up 2-megapixel camera can record video or take screenshots. Sadly, there's no Skype app, so video calling is out of the question.

## LOOK SMART

The JL9000's highlight is the webOS interface, which is one of the best-designed Smart TV systems we've seen. The long, colourful cards that appear along the bottom of the main home screen are easy to navigate, particularly when you're using the smaller 'magic' remote, and the built-in apps are decent. It would have been nice to see ITV Player and 4oD on top of BBC iPlayer and Demand 5, but the inclusion of Netflix, Amazon Instant Video, Now TV and BlinkBox make up for it. There's also Facebook, Twitter, Deezer, Picasa and Plex for LG Home Theatre, although the latter will cost you £3 from LG's app store.

The JL9000 is a great TV with excellent picture quality and top-of-the-range Smart TV services, but the soundbar adds little to its overall value. LG's cheaper LB730V series is a much better buy, as you not only get all the same services and fantastic picture quality with a more manageable stand in a wider variety of sizes, but in the case of the 55in version of the LB730V, you also get £100 knocked off the price.

Katharine Byrne



## SPECIFICATIONS

**SCREEN SIZE** 55in  
**NATIVE RESOLUTION** 1,920x1,080  
**VIDEO INPUTS** 4x HDMI, component, composite  
**TUNER** Freeview HD  
**DIMENSIONS** 709x1,227x347mm  
**WARRANTY** Five years RTB  
**DETAILS** [www.johnlewis.com](http://www.johnlewis.com)  
**PART CODE** 82458001

## CONNECTION PORTS

4x HDMI      COMPONENT      COMPOSITE

## 4K HOME CINEMA PROJECTOR

# SONY VPL-VW300ES



£5,849 inc VAT • From [www.audiovisualonline.co.uk](http://www.audiovisualonline.co.uk)

### VERDICT

A great entry-level 4K projector, but with little 4K content available, it's an expensive bit of future-proofing

**IT MAY BE** hard to believe the VPL-VW300ES is Sony's cheapest 4K projector, but when you consider the next model up costs almost twice as much, it starts to look a far more tempting prospect for anyone after a 4,096x2,160 home cinema experience.

This SXRD-based projector is huge, measuring 495x195x463mm and weighing 14kg, so you'll need plenty of room for it on a shelf. It's probably best suited to mounting on a ceiling, particularly since the menu buttons, video inputs and power supply are located around the sides of the projector and in some cases underneath the outer lip of the chassis.

Two HDMI 2.0 inputs connect external devices, but as only the second input is HDCP 2.2 compatible you'll have to use it for any HDCP-protected 4K content. Still, this means it should be future-proof for 4K streaming services and 4K Blu-ray when they eventually arrive. There's also a USB firmware update port and Ethernet for network connections. Other ports for home automation include two minijack triggers, an RS-232C remote and an IR input to extend the range of the remote.

### CONTROL FREAK

Port locations aside, the VW300ES is easy to set up, as the +85/-80 per cent vertical and +/-31 per cent horizontal lens shift, 2.06x zoom and lens focus are all controlled via the remote rather than the projector itself. It can project a screen ranging from 60in to a huge 300in, so you could have films projecting across an entire wall if you have the space.

The main problem is finding 4K content. 4K Netflix and Amazon Instant Video are both confined to compatible 4K Smart TVs. Sony says the VW300ES is compatible with its range of 'Mastered in 4K' Blu-rays, but these are 1080p movies optimised for 4K upscaling.

The only native 4K content you're likely to watch right now on the VW300ES will be still photos or 4K video footage you've shot

yourself. You'll need a PC or laptop with an HDMI output to do this, but only devices that support the HDMI 2.0 standard can output 4K video at 60fps. Most computers have an HDMI 1.4 output, which can only manage a maximum frame rate of 24fps at 4K. We tried playing 30fps and 60fps 4K clips from a laptop, but they were jerky and juddery, so we'd recommend shooting in 24fps if possible.

Buying a 4K projector today is a long-term investment rather than an instant fix, but this leaves the VW300ES feeling like a very expensive bit of future-proofing. You'll also have to buy an AV receiver with HDCP 2.2-compatible HDMI 2.0 ports to supply the audio, but at the time of writing only the £450 Onkyo TX-NR636 fits the bill.

### AS NATURE INTENDED

We can't complain about the VW300ES's picture quality. The 60fps 4K nature footage provided by Sony for testing looked stunning, showing what the projector will be capable of when 4K finally gets off the ground.

The 1,500 lumens lamp struggles to show areas of fine shadow detail with the lights on, but colours come alive in the dark. We didn't have to shroud our room in darkness either, as we could still see a huge level of detail with a bit of ambient light present.

Picture quality was outstanding from the outset, and we felt little need to tamper with the settings. There are several customisable picture modes to choose from, including two Cinema modes, Reference, TV, Photo, Game, Bright Cinema, Bright TV and User. Cinema 1 produced the most pleasing picture.

Basic contrast, brightness, colour, hue, sharpness and colour temperature settings, as well as gamma, colour correction and colour space options, can be found in the Expert Settings menu. The dynamic contrast and cinema scope options that were present in

the more expensive VPL-VW500ES are missing here, but we didn't mourn their loss.

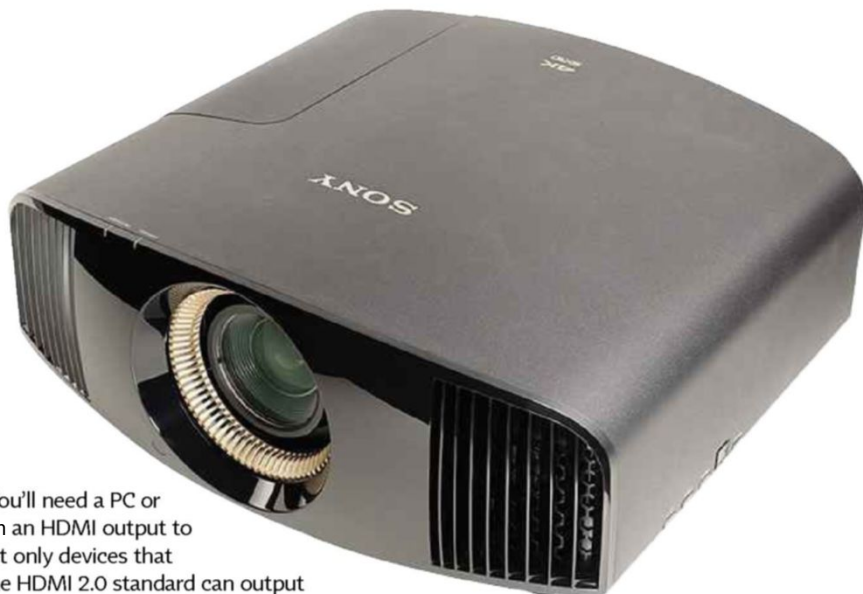
Sony's 4K Reality Creation engine is also onboard for upscaling Full HD content to 4K. Blu-ray discs showed clear sharpening and highlighting of smaller background details and facial features when paused, but the effect grew less obvious the further back we sat from the projection screen. We struggled to notice it once films were in motion. That said, general upscaling is still incredibly impressive, as the midnight forests of Pandora looked stunningly sharp and clear in *Avatar* even without Reality Creation turned on.

### GO WITH THE FLOW

Sony's MotionFlow feature, which adds extra frames to films to make them look smoother, is more pronounced. The Smooth High and Smooth Low settings are a little too pronounced for our liking, but Combination and True Cinema look much more natural.

The Sony VPL-VW300ES is a fantastic 4K projector, which will fit the bill for anyone looking to kit out their home cinema setup with the latest tech and has the cash to do it. However, because 4K content is still a rather nebulous concept outside 4K Smart TVs, we can't give it a full recommendation just yet, especially when you can get a perfectly capable Full HD projector such as Sony's VPL-HW40ES for under £2,000 and get full use out of it right now. We have no qualms about the quality of the VPL-VW300ES; we just wish there was something to watch on it.

*Katharine Byrne*



### SPECIFICATIONS

**PROJECTOR TYPE** SXRD  
**NATIVE RESOLUTION** 4,096x2,160  
**VIDEO INPUTS** 2x HDMI  
**LAMP LIFE** Not stated  
**LAMP BRIGHTNESS** 1,500 lumens  
**SIZE** 195x495x463mm  
**WEIGHT** 14kg  
**WARRANTY** Three years RTB  
**DETAILS** [www.sony.co.uk](http://www.sony.co.uk)  
**PART CODE** VVW300ES

### CONNECTION PORTS

2x HDMI





## SOUNDBAR WITH 3D BLU-RAY PLAYER

# LG SoundPlate LAB540



£370 inc VAT • From [www.currys.co.uk](http://www.currys.co.uk)

### VERDICT

Sound quality isn't brilliant, but the built-in 3D Blu-ray player and extra Smart TV services add some extra value



**TVs ARE CONTINUOUSLY** getting thinner, but this leaves less and less room for a decent set of speakers. Not everyone has space for a soundbar, which is why soundplates are becoming a popular alternative. LG's LAB540 sits beneath your TV, but goes beyond other soundplates by squeezing a 3D Blu-ray player into the front, letting you streamline your home cinema setup even further.

The LAB540 is slim and discreet at just 39.5mm high, 700mm wide and 340mm deep. According to LG it can accommodate 55in and smaller TVs, but this will very much depend on the design of your TV stand, as the wide spokes of our 46in Samsung TV left only a couple of centimetres of room in each corner. You'll also need to find room for the wireless subwoofer, but at just 296x332x296mm, it's one of the more compact subwoofers we've seen. Setup is easy, too, as it automatically pairs with the soundplate when you plug it in.

### BASS INSTINCT

Of the three sound modes to choose from, Standard is by far the most balanced. We felt it could have done with a touch more bass at times, particularly when listening to film soundtracks over Bluetooth. Our test tracks from *How To Train Your Dragon 2* sounded much flatter on the LAB540 than Samsung's similarly priced HW750 soundbar, as the LAB540 isn't able to deliver the same pounding impact of a crescendo or create the same sense of clarity between high and low sounds.

Music mode strips back the bass even further, putting a firm emphasis on the main melodies of George Ezra's 'Budapest' rather than the supporting guitars and percussion. Cinema mode redresses this balance, adding a pleasing amount of bass to the mix, but the top frequencies sound a little thin as a result, draining our music of the cinematic presence it deserves.

Turning up the volume creates a distinct muffling effect in the bass on all three modes, as if the soundplate

was straining to hit the full acoustic range of the soundtrack. It didn't happen all the time, but the subwoofer started distorting when playing tracks from *Interstellar*, creating an unpleasant high-pitched vibration as it struggled with the bass. This isn't what we'd expect at this price, and trying to adjust the levels of the four internal drivers and subwoofer did little to alleviate the problem.

Dialogue is clear but, while it's certainly a cut above the average TV speaker, it can't create the same kind of palpable atmosphere as other dedicated soundbars

The muffling isn't quite so noticeable when watching films on Blu-ray, but the LAB540 still failed to make much of an impression. Dialogue is clear but, while it's certainly a cut above the average TV speaker, it can't create the same kind of palpable atmosphere as other dedicated soundbars.

### APPY TALK

This leaves the LAB540 feeling distinctly average in terms of sound, but its 3D Blu-ray player does add some welcome extra value. It also has a host of great Smart TV apps such as Netflix, Amazon Instant Video, Now TV, Blinkbox, BBC iPlayer, Spotify, YouTube and Knowhow Movies, which is great if your TV doesn't already have these services; only LG and Samsung TVs have Amazon Instant Video, for instance. You can download more from the Apps menu as long as the LAB540 is connected to your home network.

The LAB540 will even upscale to 4K if you have an Ultra HD TV, bypassing the upscaling algorithms on the TV itself in favour of LG's own. However, the lack of picture options means you'll still have to adjust the final image using your TV's menus if you want to alter the colours or contrast.

You can use the Blu-ray menu to watch content from any connected device, including PCs on your home network or a flash drive using the USB port on the back of the plate. It supports a wide range of files, too, so it should be able to play almost anything, including MP3, FLAC, M4A, OGG and WMA audio files and MP4, MKV, XviD, DivX, MOV,

WMV and AVI video files. You can also hook up other sources through the HDMI and S/PDIF audio inputs on the back. You'll find an Ethernet port here as well, although you're unlikely to use it thanks to built-in Wi-Fi.

### STAR QUALITY

Our *Star Trek* Blu-ray looked excellent, with image quality surpassing our reference Blu-ray player. Each scene was sharp and darker scenes showed hardly any noise whatsoever. DVD upscaling was naturally a lot fuzzier round the edges, producing images that were often a little too soft compared to our reference screen grabs. That means less noise and compression, but also less detail. Text and lettering was also hazy, but still acceptable.

The LG LAB540 doesn't excel as a sound system, but if you've yet to buy a 3D Blu-ray player and aren't satisfied with your TV's speakers, it's a decent all-in-one bundle that's compact and living room-friendly. However, at £370, it's rather expensive. If space isn't an issue, LG's NB3540 soundbar and the Best Buy-winning Samsung BDH6500 3D Blu-ray player together cost around £70 less.

Katharine Byrne



### SPECIFICATIONS

**SPEAKERS** 4.1  
**RMS POWER OUTPUT** 320W  
**DIMENSIONS** 700x320x39.5mm  
**WEIGHT** 3.76kg (soundplate), 7.64kg (subwoofer)  
**DOCK CONNECTOR** No  
**NETWORKING** Wi-Fi, Bluetooth, DLNA  
**WARRANTY** One year RTB  
**DETAILS** [www.lg.com](http://www.lg.com)  
**PART CODE** LAB540

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# CREATIVE Sound Blaster X7

COMPUTER  
SHOPPER  
RECOMMENDED



£286 inc VAT • From [www.lambda-tek.com](http://www.lambda-tek.com)

## VERDICT

A worthy audio upgrade that looks great and can be used in a number of different ways

**AUDIO FIDELITY IS** just as important as visuals when it comes to immersion, but it's often overlooked; your PC or laptop's on-board audio chip can often be an area where manufacturers make cost-savings, resulting in compromised sound quality. Creative's Sound Blaster X7 bypasses these integrated digital-to-analogue converters (DACs), and will also work with other devices including your TV, games console or tablet.

The X7's pyramid-like black and gold design is eye-catching, and despite housing both a Burr-Brown PCM1794 DAC and a Texas Instruments TPA6120A2 headphone amplifier it's surprisingly light and small.

The X7 can hook up to any PC or laptop via USB, but that's just the start in terms of connectivity. A digital optical output lets you connect to a set of active speakers, while RCA and 3.5mm connections let you plug in a set of 5.1 analogue speakers. This is a bit limiting, however, if your sound system extends beyond five speakers and a subwoofer.

## HEADS UP

There are 6.3mm and 3.5mm headphone jacks on the front, as well as a microphone jack. The headphone amp is able to drive a pair of headphones up to 600 ohms, which means you can use even the most demanding headphones. A headphone stand attaches to the rear of the X7 to display your cans, but we found the stand rather flimsy.

Low latency Bluetooth 4.1 is built-in, letting you connect a Bluetooth device to turn any connected speakers into wireless ones. An NFC pairing point pairs compatible devices in a matter of seconds. Because the X7 uses the less-lossy aptX codec, it should maintain the audio fidelity of your source, and the low latency component ensures there's minimal delay. This is crucial if you're watching movies with the audio synced through Bluetooth, and in our testing it worked perfectly.

An optical input will let the X7 manage sound for a TV or games console, and a USB port on the side of the unit acts as a USB host, letting you connect an Android or iOS device. This will provide superior sound quality from a smartphone or tablet than using the headphone jack, as the X7 will handle the digital-to-analogue conversion as well as acting as an amplifier. Your Android device will need to support USB On-The-Go, however.



Two pairs of speaker terminals on the back will even let you hook up a pair of passive speakers. They accept bare wire or banana plugs, and can drive 4- or 8-ohm speakers, with a switch on the back toggling between the two. Out of the box the X7's amp can power two 38W speakers, but this can be boosted to two 50W speakers with a power adaptor.

Finally, a built-in beamforming microphone supports Creative's CrystalVoice technology to improve voice pick-up and reduce background noise. It worked well during Skype chats and we were able to speak normally without sound from a TV being picked up as well. You can also use the X7 for hands-free calls with a Bluetooth-connected smartphone.

## SIGNATURE DISH

An adjustable equaliser lets you tweak the sound signature of each source using the Sound Blaster software for Windows and Mac, or the apps for iOS and Android. Sound Blaster's SBX Pro Studio enhancements are here as well; they include a Surround mode that expands the soundstage, and Crystalizer, which improves the sound quality of low-quality audio. There's also Dialog Plus, which is useful for enhancing dialogue in movies.



It's possible to adjust each enhancement and we found that adding a touch more surround and increasing the bass slightly provided the best experience with our test headphones and speakers. Once you've set the levels using the app or desktop software, they're saved to the X7 so toggling the SBX mode on and off will remember your settings.

Sound quality is naturally dependent on what you connect to the X7 and the sources you're listening to; it can decode Dolby Digital signals and the DAC supports high-resolution, 24-bit/192kHz audio. We tested with an array of headphones, including the Philips Fidelio M2BT and the Sennheiser HD 700, which both sounded fantastic. The latter have an impedance of 150 ohms and required only about 30 per cent of maximum volume, so there's lots of overhead for more demanding cans. With USB host mode the X7 makes it viable to use more demanding headphones with underpowered devices that would otherwise not provide enough volume.

## MASTER BLASTER

The Creative Sound Blaster X7 serves many purposes and it does them all with gusto. We only wish it had support for more than 5.1 surround. There's otherwise not a great deal to complain about except the price, which isn't going to make the X7 an impulse buy. There are also options that won't appeal to many people, such as the swappable op-amps in the base, which we don't see anyone using. We also had to plug our headphones in again after a computer reboot in order to get sound, which was inconvenient.

In the end, though, if you are looking to upgrade your audio and have more than one source you want to use, the Creative Sound Blaster X7 is a great choice.

Richard Easton

## SPECIFICATIONS

**WARRANTY** Two years RTB

**DETAILS** [uk.creative.com](http://uk.creative.com)

**PART CODE** Sound Blaster X7



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## BLUETOOTH HEADPHONES

### PHILIPS Fidelio M2BT

COMPUTER  
SHOPPER  
BEST BUY



£193 inc VAT • From [www.amazon.co.uk](http://www.amazon.co.uk)

#### VERDICT

The Fidelio M2BT is a worthy follow-up to the supremely excellent M1BT set

**THE ORIGINAL FIDELIO** M1BT impressed us with its good looks and excellent sound, so we weren't surprised to see that Philips hasn't strayed far from a winning formula for its follow-up. The most obvious change is a new fabric headband made from toughened fibres. We slightly prefer the M1BT's stitched leather, but the M2BT is still a good-looking pair of headphones. Its understated design is a nice contrast to the 'street'-inspired headphones that dominate the market, and it's well made and extremely comfortable thanks to its memory foam earpads.

#### SPECIFICATIONS

**HEADPHONES SUBTYPE** On-ear Bluetooth  
**PLUG TYPE** 3.5mm jack plug  
**WEIGHT** 190g  
**CABLE LENGTH** 1.2m  
**WARRANTY** One year RTB  
**DETAILS** [www.philips.co.uk](http://www.philips.co.uk)  
**PART CODE** Philips Fidelio M2BTBK/00



The earpads sit on your ears rather than enveloping them. Some sound leaks out at high volumes, but it's only **minor**. The headband adjusts on sliding rails and is just tight enough to secure the headphones without being uncomfortable.

A wheel on the right earcup lets you adjust the volume by tilting up or down, and pushing it in skips tracks. A larger button plays and pauses your music and lets you answer calls with the built-in microphone. A second mic measures ambient noise and adjusts levels **accordingly**. Call quality was clear and the mic didn't struggle to pick up our voice.

The M2BT supports both Bluetooth 4.0 and the less lossy aptX codec for superior sound quality, while NFC on the ear cup makes it easier to pair compatible devices. AAC is supported for Apple smartphones too.

Philips rates the battery life at 10 hours, and this seemed accurate from our experience. We charged the headphones only

once a week, and used them during the daily commute and some light use throughout the day. We had no trouble using the headphones to make hands-free calls **either**.

A 1.2m cable is included, so you can continue listening to music if the battery dies. A wired connection is also your best option if you value sound quality and don't have an aptX-compatible audio device.

Sound quality from the M2BT was a delight. Tracks sounded detailed across the frequency spectrum and bass was tight but not overbearing. Dance tracks were injected with energy but the M2BT also reproduced the subtle tones of our instrumental tracks. It was also supremely comfortable and at no point did our ears become too warm or tired.

The M2BT headphones are a fantastic follow up to the Fidelio M1. They look great and sound even better.

*Richard Easton*

## BLUETOOTH STEREO SPEAKERS

### WAVEMASTER Cube



£118 inc VAT • From [www.eclipsecomputers.com](http://www.eclipsecomputers.com)

#### VERDICT

Wavemaster's Cube Bluetooth speakers sound great and are simple and easy to use

**THE WAVEMASTER CUBE** looks like a typical pair of bookshelf speakers with a somewhat functional black design, but it makes up for a lack of visual flair with its excellent sound.

Each acoustically dampened MDF cabinet holds a 25mm silk dome tweeter and a 13cm mid-range/woofer driver, while power comes from a built-in amplifier. The power/volume and source selection dials on the front of the right speaker protrude quite far out and aren't

particularly attractive, though, which detract from the otherwise uncluttered design.

The speakers connect to each other with bundled speaker wire, which is more than long enough for a desk or **bookshelf**, and the right speaker connects to the mains. The system goes into standby after a short period of idleness and turns on automatically once it receives a wired signal.

A pair of RCA phono connectors and a 3.5mm auxiliary input on the back of the right speaker allow you to connect wired devices such as a PC or laptop, but the Cube's party piece is Bluetooth. **Sadly**, it uses the Bluetooth 2.1 standard rather than the newer version 4.0, and omits support for the less lossy aptX audio codec or Apple's AAC in favour of the basic SBC codec. There's no NFC quick pairing **either**, which would have been a real bonus.

The difference in sound quality between Bluetooth and wired sources was slight when



playing **low-bit rate**

MP3s or streaming audio, but there was a subtle improvement using Line In with a higher-quality source.

Sound quality felt transparent, with plenty of detail in the mid range and treble in **particular**. Certain tracks benefit from a slightly higher treble, but the Cube has treble and bass adjustment dials on the back of the right speaker – it took only a little bit of adjustment to improve playback. Pushing the Cube to beyond 90 per cent volume resulted in bass distortion and made for uncomfortable listening, but it's still loud enough to fill a medium to large room.

It's a minor complaint for what is otherwise a great sounding pair of speakers that are supremely easy to use, whether as Bluetooth wireless bookshelf speakers or an upgrade for your PC or hi-fi speakers if you have space.

*Richard Easton*

#### SPECIFICATIONS

**SPEAKERS** 2  
**RMS POWER OUTPUT** 25W  
**DOCK CONNECTOR** None  
**WIRELESS** Bluetooth (A2DP)  
**DIMENSIONS** 175x200x245mm  
**WEIGHT** 5kg  
**WARRANTY** One year RTB  
**DETAILS** [www.wavemaster.eu](http://www.wavemaster.eu)  
**PART CODE** SPW-THECUBE

## SELFIE CAMCORDER

# CANON Legria Mini X

COMPUTER  
SHOPPER  
RECOMMENDED



£299 inc VAT • From [www.wexphotographic.com](http://www.wexphotographic.com)

### VERDICT

The Canon Legria Mini X has a fantastic articulating screen for shooting selfie videos but image quality left us a little disappointed

**VIDEO BLOGGING, OR** vlogging, is hardly a new phenomenon but it's bigger now than ever. Many YouTube stars make do with the camera built into their laptop or smartphone, but there's a market for those who want higher-quality video and audio to increase the production values of their creations. The Sony HDR-MV1 was one of the first such devices, and the Canon Legria Mini X is the latest.

While the HDR-MV1 was tall and slim, the Canon Legria Mini X is squat and flat, which we prefer. At 30x82x109mm it's slightly larger than the HDR-MV1 but remains respectably light at 205g. It's small enough to fit in a pocket or bag for impromptu videos.

The HDR-MV1 had an LCD screen, but its position on the side of the unit made it hard to frame videos when shooting 'selfies'. The Legria Mini X's articulating screen is a better approach. With its two-hinge design it can be propped up and rotated vertically for selfie videos, tilted back to shoot video in a more conventional way or folded flat for easy storage. An orientation sensor inside the display automatically rights the display.

### STAND AND DELIVER

A kickstand in the base of the camera can be tilted and angled in various ways, although each position tilts the camera upwards, which is rarely the most flattering angle. There's a standard tripod thread in the base though, so you could always attach a tripod for more angle options.



The 2.7in LCD is also a capacitive touchscreen, which makes changing settings easier than dealing with buttons. We found some of the icons a tad small and struggled with the onscreen keyboard, but it's not something you'll need to use often. The screen is reasonably bright, making it easy to see outdoors, and is a quick way of playing back footage, although the 230,000-dot resolution makes footage look rather grainy.

The Legria Mini X has built-in Wi-Fi for connecting to the optional CameraAccess Plus app. It's available on iOS and Android, but at time of writing, Android 5.0 Lollipop wasn't supported. The app lets you control the camera from a phone or tablet. Live view has around a 2.5 second delay, however, which feels jarring. The Legria Mini X's microphones also relay audio to your device, and you can connect directly to the camera to access and play back the videos from the SD card through a browser interface.

'Monitor while Out' mode lets you connect the camera to your home Wi-Fi and access it remotely. You input your Wi-Fi details on the Legria Mini X's touchscreen, which is slicker than other IP cameras that rely on companion apps or computers. Alternatively, you can use WPS for push-button pairing. Both methods worked well when we tried them.

Pairing the camera with a free Canon Image Gateway account lets you upload videos directly to Facebook, Twitter, YouTube and Flickr. This can be slow, however, and we were often left staring at loading screens while the camera connected to the internet.

The Legria Mini X's lens has an f/2.8 aperture and 160° field of view in video mode, expanding to 170° for still images. It records 24Mbit/s AVCHD video at 1080p/25p resolution, although videos looked slightly soft with a lot of purple fringing between the high-contrast areas such as buildings against sky. There was also some mosquito noise, where edges of objects appear to shimmer.

Indoors, where the Legria Mini X is perhaps most likely to be used, there was a lot of noise in areas of shadow. The 160° wide-angle lens also introduces a lot of barrel distortion, which deforms objects closest to the camera. Zooming in corrected the barrel distortion, but there's only one zoom level and this uses digital zoom so you sacrifice some image quality. The Legria Mini X can



also capture 12-megapixel still images, but without ample light these appear noisy.

Battery life was excellent, however. When shooting 1080p MP4 video and AAC audio, the Legria Mini X lasted 2h 52m on a single charge, which is plenty for a vlog post.

### WIND BREAK

The twin stereo microphones can capture Linear PCM audio. This is important for anyone who values audio fidelity, as it's completely lossless. Linear PCM audio is only available in AVCHD mode, however, and results in large video size. You'll need to buy a large SD card as there's no built-in storage and no memory card is included. The microphones have integrated windshields that cut down on unwanted noise, and there are also 3.5mm mic and headphone jacks for connecting an external microphone and monitoring levels.

The microphones are impressively sensitive. Shooting from the roof of our office we were able to pick up even faint sounds from a large distance. Their directionality was great too, with sound following the direction of the camera. You can also apply different audio scenes including speech, noise suppression and meeting, with the latter clearly detecting multiple speakers.

The Legria Mini X gets a lot of things right, particularly the articulating screen. The microphones are super sensitive and capture high-quality audio. However, video quality was disappointing and we preferred footage shot on Sony's HDR-MV1. Each camera has its pros and cons, though; which is best for you will depend on what you'll mainly be filming.

Richard Easton

### SPECIFICATIONS

**OPTICAL ZOOM** None  
**SENSOR** 1½in BSI CMOS  
**LCD SCREEN** ½in, 230,000 dots  
**SIZE (HxWxD)** 30x82x109mm  
**WEIGHT** 205g  
**WARRANTY** One year RTB  
**DETAILS** [www.canon.co.uk](http://www.canon.co.uk)  
**PART CODE** Legria Mini X



## YOUVIEW SET-TOP BOX

# BT Mini YouView Box



£100 inc VAT • From [www.shop.bt.com](http://www.shop.bt.com)

### VERDICT

A neat way to give an old TV a smart upgrade, but there's no media streaming or Wi-Fi

**THE YOUVIEW PLATFORM** wasn't designed exclusively for use in PVRs, but until now those were the only devices we'd seen that offered it. BT changes that with its Mini YouView Box (also known as the Zapper), a set-top box that gives you YouView without the ability to record. Although BT branded, it's available for non-BT customers, too.

The Mini YouView Box is small, square and only a little larger than an Apple TV but still discreet enough to tuck neatly out of the way. On the back it has an HDMI output, an aerial socket and an Ethernet port, which you'll have to use to get the device online as there's no Wi-Fi. The single USB port is only used for firmware updates.

### STRONG CURRENT

With no PVR facilities, the Mini YouView Box is primarily designed for watching live TV. This might make it redundant for owners of newer TVs, as in effect it doubles up on features your TV may already have. At least it has an HD tuner, which could be a good upgrade for those with older TVs.

Although you can't record programmes, the built-in memory enables you to pause and rewind live TV. The device has enough memory to store up to around 30 minutes of an SD channel or 15 minutes of an HD channel, which gives you more than enough time to answer the door, put the kettle on or make a quick phone call.

The device also benefits from the brilliant YouView electronic programme guide (EPG), which pulls in information from the internet and is one of the best. It provides more information than a regular EPG, such as when more episodes of a show will be broadcast.



↑ You can't record programmes on the Mini YouView box, but you can still pause and rewind them, with up to half an hour's buffering



↑ The EPG is full of useful information, such as when future episodes of a programme will be broadcast

As well as showing you when programmes will be on in the future, the EPG lets you step backwards through the schedule and watch programmes that are available through the main catch-up services (BBC iPlayer, ITV Player, 4oD and Demand Five). When the EPG suggests other episodes of a programme, they may be live or available through the on-demand service. It's this seamless integration of live and on-demand TV that sets YouView apart from the competition.

You can also access each on-demand service through its own app. This presents you with a wider back catalogue of content from each provider. Essentially, from here you can choose from the same range of programmes you would get by going to each TV channel's website.

### SECOND SERVICE

Since it launched, the YouView platform has been extended with new players and services. An early addition was the excellent pay-as-you-go Sky Now TV service, which provides cheap access to the broadcaster's top channels, including Sky Atlantic, Sky Sports and Sky Movies. Another more recent addition to the line up is Netflix. Sadly, there's no way of streaming content over your local network or adding an app that will do so.

If you hook the YouView box up to a BT Broadband connection and subscribe to a TV package with the company, you also get the

BT Player. You can access this through the YouView menu or by hitting the big BT Player button on the remote control. The app gives you access to a range of free on-demand programmes, including TV box-sets and movies. You can also rent or buy movies in SD or HD and stream them over your internet connection.

BT Sport is included in the basic package and streamed over the internet to your YouView box. If you upgrade to the TV

Entertainment package (currently £5 a month for six months, rising to £7.45 plus a £35 activation fee), you get additional streamed TV channels, which appear in your box's EPG. These include History, Animal Planet, Discovery and Syfy. If that's not enough, you can add more internet channels, including Sky Sports 1 and 2, although at this point you're eligible for a free BT YouView+ box, which has two tuners and can record programmes too.

### NET WORTH

Deciding whether or not the BT Mini YouView Box is worth buying really depends on what you want and whether or not you have BT broadband. If you don't, the £100 price nets you a decent Smart TV upgrade for an older TV that gives you access to all the main on-demand services, plus Now TV and Netflix. With the ability to pause live TV, it's a great upgrade for anyone who doesn't need to record TV. The fact that you can't stream local media will be a little disappointing for some though.

If you subscribe to BT Broadband, however, the choice is a lot easier. Existing customers can get the TV Starter package, including this box, for free, with a one-off activation fee of £35. That's incredible value.

If you've already got a BT TV subscription and a YouView+ box, you can pay an extra £5 a month to get this box for a second room, as well as TV Anywhere streaming for your tablet or smartphone. Again, it's great value if you want to upgrade a second TV somewhere else in your house.

As good as this box is, however, it's not a single do-everything box for all types of media, and the lack of Wi-Fi is disappointing, particularly if you pay full price for it.

David Ludlow

### SPECIFICATIONS

**TUNERS** 1x Freeview HD (YouView)  
**DIMENSIONS** 130x130x35mm  
**NETWORKING** Gigabit Ethernet  
**INTERNAL DISK CAPACITY** None  
**WARRANTY** One year RTB  
**DETAILS** [www.bt.com](http://www.bt.com)  
**PART CODE** 078930

# AOC

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1 ms GtG / 144 Hz

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Developed by gamers for gamers: The brand-new 61 cm (24") FullHD monitor for the ultimate viewing experience in gaming. **It boasts a 144 Hz refresh rate and the ultra-short pixel response time of one millisecond**, providing a lag-free, real-time gaming experience. Allowing the extremely short response time of just one millisecond for richly detailed, extra-clear and crisp images without ghosting effects. In addition, the g2460Pqu refreshes the picture up to 144 times per second, more than doubling the standard rate of 60 Hz and delivering super-smooth pictures. This especially comes in handy when playing first-person shooters, when enemy movements need to be detected rapidly and clearly. **Finally no more screen tearing!**



Innovative height adjust stand (130mm)



USB 2.0 Hub with fast charging port



Without ghosting effects by one millisecond



3 years warranty

### PRODUCT DETAILS

- Inputs: D-Sub, DVI-D, HDMI, Display port
- Upto 1 ms GtG
- 1920 x 1080 @ 144 Hz
- Special Features: -5°~+15° Tilt, Swivel, 130 mm height adjust
- 350 cd/m<sup>2</sup>
- OSD with specialed and customizable pre-sets for best performance in various types of games



## FLATBED SCANNER

# EPSON Perfection V37



£78 inc VAT • From [www.amazon.co.uk](http://www.amazon.co.uk)

### VERDICT

The Perfection V37 is a good scanner, but at this price we'd rather have an MFP

**YOU CAN BUY** much cheaper scanners than the Perfection V37, but at least it has an impressive 4,800 dots per inch (dpi) maximum resolution. Other than that it's rather basic. There's no support for Wi-Fi, and it doesn't come with a backlight for scanning film – for £12 more, the otherwise-identical Perfection Photo V370 does.

### SPECIFICATIONS

**SCANNER TYPE** Flatbed scanner  
**MAXIMUM OPTICAL SCAN RESOLUTION** 4,800x9,600dpi  
**DIMENSIONS** 41x280x430mm  
**WEIGHT** 2.2kg  
**WARRANTY** One year RTB  
**DETAILS** [www.epson.co.uk](http://www.epson.co.uk)  
**PART CODE** B11B207301



It's a fairly slim device, with a footprint about the size of an A3 sheet. With no automatic document feeder (ADF) the lid is also quite thin. It's mounted on an articulated hinge that opens more than 180° and can close on thick documents such as books.

The Perfection V37 has a decent software bundle that includes ABBYY FineReader Sprint for optical character recognition (OCR) and ArcSoft MediaImpression to help organise scanned images. Epson's own scan interface works in several modes, from fully automatic to Professional. It's easy to use on any setting, and comes with useful features such as auto marquee, which detects the original and makes a selection automatically, and automatic exposure. There's even a thumbnail feature that crops and separates multiple documents scanned at once – perfect for archiving receipts or scanning several photos.

It isn't the fastest scanner, taking 12 seconds to preview the platen, 13 seconds to

capture an A4 page at 150dpi, and 17 seconds to do the same at 300dpi. It took 18 seconds to capture a 6x4in photo at 600dpi but 74 seconds to do the same at 1,200dpi. At the maximum 4,800dpi it took over half an hour.

The results were excellent at lower resolutions, with accurate colours and a huge dynamic range, successfully picking out every shade in our test pattern. Scans remained impressive up to 1,200dpi, but at 2,400dpi and above a softness was visible at sharp colour boundaries, suggesting that the optics aren't a match for its maximum resolution.

The Perfection V37 is a good scanner, but it doesn't do enough to distance itself from a scanner you'd find in a good quality MFP. Canon's Pixma MG5650 costs less and produces similarly good scans up to its maximum 1,200x2,400dpi, so unless you categorically don't want an inkjet printer, we'd recommend that instead.

Simon Handby

## MONO LASER MFP

# CANON i-SENSYS MF6180dw



£299 inc VAT • From [www.viking-direct.co.uk](http://www.viking-direct.co.uk)

### VERDICT

Fast, without prohibitive running costs, Canon's MF6180dw is a good all-in-one for a busy micro office

**THIS MONO LASER** MFP is aimed at small offices or busy home offices, with a quoted 33 pages per minute print speed, fax modem and

### SPECIFICATIONS

**TECHNOLOGY** Mono laser  
**MAXIMUM PRINT RESOLUTION** 600x600dpi  
**MAXIMUM OPTICAL SCAN RESOLUTION (OUTPUT BIT DEPTH)** 600x600dpi  
**DIMENSIONS** 431x390x473mm  
**WEIGHT** 19.1kg  
**MAXIMUM PAPER SIZE** A4/legal  
**WARRANTY** Three years onsite  
**DETAILS** [www.canon.co.uk](http://www.canon.co.uk)  
**PART CODE** 8482B031AA



support for wired or wireless networks. The 50-sheet ADF can handle both sides of a page for making unattended double-sided prints, scans, copies or faxes.

It took us a while to learn and understand the buttons, thanks to indistinct icons. We're not sure why Canon doesn't fit a touchscreen as it does on its high-end Pixma inkjets. The controls are comprehensive, though, with support for scans to a USB device, email or a network folder and for walk-up printing.

Printers often lag behind their rated speeds in our tests, but the MF6180dw came very close. Thanks in part to a fast first-page-out time of just six seconds, it reached exactly 30ppm in our text test, and an impressive 26.2ppm when printing mono graphics. Duplex (double-sided) printing was also fast, with 10 sides printed on five sheets in 52 seconds. Scans were similarly quick, with an A4 document captured at 150dpi in just 11



seconds. A single-page photocopy took seven seconds, while 10 pages took just 29 seconds.

Text quality was excellent, but graphics were printed with visible dither patterns. We rarely have cause to criticise Canon scanners, but images weren't perfectly exposed, with areas of text casting a subtle shadow.

Using the single 6,400-page consumable, running costs should work out at just 1.4p per page. Reasonably priced, with fair running costs and superb speed, the MF6180dw is an MFP we're happy to recommend.

Simon Handby

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## POCKET-SIZED PORTABLE SSD

# SAMSUNG T1



£229 inc VAT • From [www.overclockers.co.uk](http://www.overclockers.co.uk)

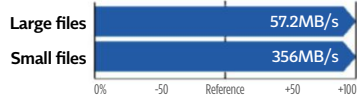
### VERDICT

Super-fast, ultra-compact and secure, Samsung's T1 is a fantastic portable SSD

**THE T1 SQUEEZES** 500GB of storage into a case measuring 71x53x9mm and weighing just 30g. It's small enough to slip in a pocket or bag and forget it's even there – so much so that we were worried about losing it. A key ring loop would have put our minds at ease.

### SPECIFICATIONS

**CAPACITY** 500GB  
**COST PER GIGABYTE** £0.46  
**INTERFACE** USB3  
**CLAIMED READ** 450MB/s  
**CLAIMED WRITE** 450MB/s  
**WARRANTY** Three years RTB  
**DETAILS** [www.samsung.com](http://www.samsung.com)  
**PART CODE** MU-PS500B/EU



See page 72 for performance details



The T1 is based on Samsung's 850 EVO (see page 99), and uses the same MEX/MGX SSD controller. This, combined with a USB3 connection and support for the USB Attached SCSI protocol, should give the drive a speed edge over high-capacity USB flash drives.

This was borne out in our tests. The T1 wrote large files at 319.7MB/s and read them at 392.3MB/s. That's more than twice as fast as the largest USB flash drive we've reviewed – the SanDisk Extreme Pro USB 3.0.

Our intensive small-files test is tougher, but the T1 still managed to write at a rapid 42.5MB/s and read at 71.9MB/s. This is twice as fast as our high-capacity USB flash drive.

Out of the box, the T1 is formatted with the exFAT file system and supports AES-256 encryption, which business users will appreciate for protecting sensitive data.

With no moving parts, the T1 is completely silent and should survive greater shocks and vibrations than a mechanical external hard

disk. We dropped it on a range of surfaces and our data remained intact. The lack of noise will certainly appeal to anyone who currently uses a noisy mechanical disk, too.

The T1 has seriously quick transfer speeds and a large capacity in a pocket-size package. It's a cut above a USB flash drive and more portable than other external SSDs we've seen. At £229, the 500GB model isn't exorbitant, considering the only 512GB flash drive we could find costs over £100 more. Competing portable SSDs cost around £20 less but are physically much larger. We feel the T1's size justifies the extra cost. While a 500GB mechanical hard disk costs significantly less, these can't match the T1 for speed and are more vulnerable to shock damage.

If you need to carry a sizeable amount of storage with you at all times and don't want to worry about knocks and drops killing your data, the T1 is an excellent buy.

Tom Morgan

## MINI-ITX PC CASE

# CORSAIR Graphite 380T



£114 inc VAT (black model), £123 (other colours) • From [www.ebuyer.com](http://www.ebuyer.com)

### VERDICT

The whisper-quiet Graphite 380T is compact and looks great but still has ample room for components

**THE GRAPHITE 380T** PC case is a compact variant of the 760T (see Reviews, Shopper 324). It takes Mini-ITX motherboards, but don't let size fool you – there's room inside for some seriously powerful components.

A handle on top makes the 380T ideal for taking on the move. Our full system weighed 9.4kg, which we could easily carry with one hand. Unfortunately, you can't lock the case, which could be a problem at LAN events.

### SPECIFICATIONS

**CASE TYPE** Mini-ITX  
**MOTHERBOARD COMPATIBILITY** Mini-ITX  
**SUPPLIED FANS** 1x 120mm, 1x 140mm  
**MAX 3 1/2IN DRIVE BAYS** 2  
**MAX 5 1/4IN DRIVE BAYS** 0  
**SIZE** 393x292x356mm  
**WEIGHT** 5.6kg  
**WARRANTY** Two years RTB  
**DETAILS** [www.corsair.com](http://www.corsair.com)  
**PART CODE** CC-9011061-WW

A three-speed fan control button joins the two USB3 ports and twin 3.5mm audio jacks on the front panel. At the lowest setting, we could barely hear the internal fans over the sound of the CPU cooler and graphics card, but you can ramp up the speed (and volume) if you need better cooling.

You have to screw down the motherboard, but virtually every other fitting in the 380T is tool-free. Oversized handles pop off the side panels, the graphics card is held in place with thumbscrews and the two dedicated 2 1/2in drive bays use spring-mounted clips to hold disks in place. Be aware that there are no 5 1/4in external drive bays, so you won't be able to fit an optical drive.

There are mounts for two 120mm fans on the side, but with one 140mm and one 120mm fan fitted already and each side panel covered in wire mesh to maximise air circulation, it kept a Core i5 CPU below 55° at idle using



Intel's stock heatsink – an impressive achievement for a mini-ITX case.

Despite the small size, we comfortably fitted a dual-slot Radeon R9 280X and still had room left over. You should have no trouble fitting the most powerful of graphics cards.

Cable management is usually an afterthought on mini-ITX cases, but the Graphite 380T has plenty of room beneath the motherboard tray and enough cable tie loops to create a very tidy system. Combined with the white LED built into the roof, it's easy to swap out components or change jumpers.

It won't blend into your home cinema as other mini-ITX cases do, but if you want something portable that also stands out, the 380T is an excellent case.

Tom Morgan

## FUZE Fuze-T2-R



£230 inc VAT • From [www.fuze.co.uk](http://www.fuze.co.uk)

### VERDICT

Fuze Basic is a fun introduction to coding, but the Fuze case is hampered by a poor keyboard

**FUZE AIMS TO** capture the nostalgia of early-days home computing by housing a Raspberry Pi B+ inside a retro-inspired, powder-coated steel case that resembles a BBC Micro or Commodore 64. The Fuze-T2-R kit (£270) is at the top of the range, with extras that include a VCom DM501 wireless mouse that tracks well on carpet and a USB-controlled robotic arm kit.

Hardware is only half the story, however. At the heart of the project is Fuze Basic, a re-tooled version of the Basic programming language that runs on a Raspberry Pi. As Fuze is primarily concerned with helping children get into coding, whether at home or school, Basic is a reasonable starting point. The syntax is straightforward, the commands are comprehensible and it's powerful enough to

With the first batch of project cards complete, we moved on to the robot arm. This comes in kit form – like a cross between Lego Mindstorms and Airfix – and takes between four and six hours to construct depending on how fussy you are about smoothing off the moulding burrs. While we had fun moving the arm by tapping keys on the keyboard, the coding certainly wasn't stress-free.

## At the heart of the project is Fuze Basic, a version of the Basic programming language that runs on a Raspberry Pi

create complex and impressive programs. Fuze has produced a set of guides called 'project cards' to demonstrate certain concepts and commands, which in all but the most basic kit (the Pi-less, £70 Fuze-T2-C) have been collated into a glossy booklet.

The project cards are written in a breezy, light-hearted tone, even if the humour sometimes tries too hard to be wacky. Each card demonstrates how to use certain coding fundamentals by creating an interesting program, before challenging you to use your coding skills to modify or expand on the concepts introduced. It's to the credit of the project card writers that finishing the projects in our booklet left us wanting more. Fuze told us that it is already writing project cards that will demonstrate how to use the buttons, thermistor and single-digit read-out included in the kit's electronics box, and we can also look forward to project cards for games and a basic painting program, among other applications.

This wasn't because of the 70-odd lines of code we had to type, but the built-in keyboard we had to type on. The keys rattle cheaply in their mounts and have so much travel before registering a keystroke that it's hard to adopt a natural typing style. The space bar is particularly annoying as it sits flush with the case – try to slap it with the side of your thumb and you'll just hit case. Even with a more hen-peck typing style you have to hit the space bar quite centrally to register the keystroke. These are not small quibbles for a system designed for coding, where syntax and correctly placed spaces are essential.

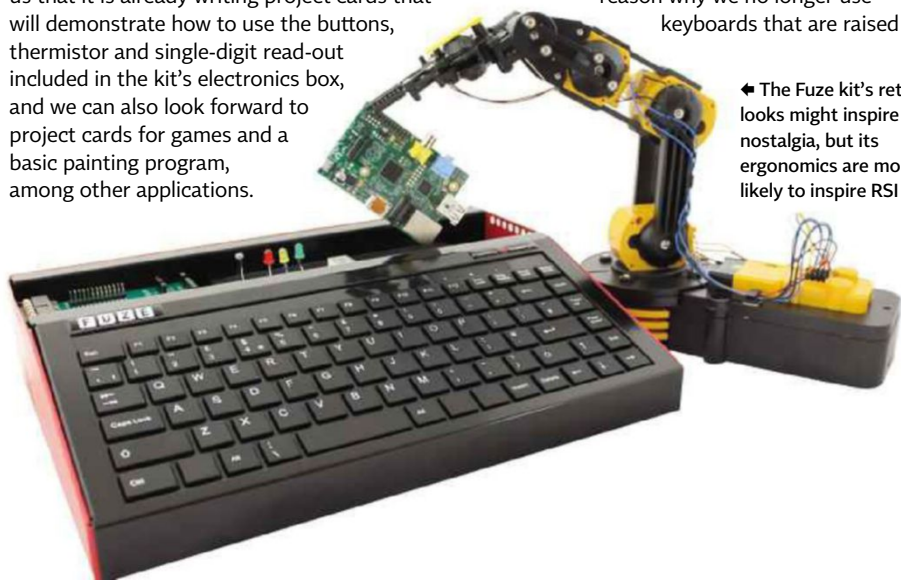
While the appearance of the Fuze case might be quaintly old-fashioned, there's a reason why we no longer use keyboards that are raised

35mm from our desks with a rake of almost 20°: ergonomics. Type with any proficiency for any length of time on the Fuze and the tendons in the back of your hand will scream at you to stop. At least the keyboard, and the case in general, feel rugged.

There's also the issue of price. An equivalent bundle using a standard Raspberry Pi case, our award-winning £19 Microsoft Wired Desktop 600 set, a nice folder to store project card print-outs and the standalone robot arm kit (£35 from [www.maplin.co.uk](http://www.maplin.co.uk)) costs roughly £100 less than the Fuze-T2-R. You can also download Fuze Basic for a Pi running Raspbian for free from [www.fuze.co.uk/resources-2](http://www.fuze.co.uk/resources-2). There's no way to replicate the Fuze I/O break-out board, though, which is so tightly integrated into Fuze Basic that it's near-impossible to interact with electronics such as LEDs and buttons without it.

Unfortunately, the most useful elements of this bundle are Fuze Basic and the project cards, which are both free to access, install and use. What you're actually paying for is the Fuze case and its inadequate keyboard. Even if your (or your child's) typing style is more hen-peck than touch-type, the space bar problems and the price are enough to warrant building your own Pi setup with a standard keyboard. We think schools would also appreciate the ability to swap damaged or dirty keyboards without replacing an entire case unit. At £35, the robot arm kit is worth a play, but we wouldn't bother with a Fuze case.

*Clive Webster*



◀ The Fuze kit's retro looks might inspire nostalgia, but its ergonomics are more likely to inspire RSI

### SPECIFICATIONS

**PROCESSOR** 700MHz Broadcom BCM2835

**RAM** 512MB

**FRONT USB PORTS** None

**REAR USB PORTS** 4x USB

**TOTAL STORAGE** 8GB

**GRAPHICS CARD** Dual-core Broadcom VideoCore IV

**DISPLAY** None

**OPERATING SYSTEM** Raspbian, with Fuze add-ons

**WARRANTY** One year RTB

**DETAILS** [www.fuze.co.uk](http://www.fuze.co.uk)

**PART CODE** FUZE-T2-R



## PHOTO-EDITING SOFTWARE

# ACDSEE Pro 8



\$90 (around £60) • From [www.acdsee.com](http://www.acdsee.com)

### VERDICT

Plenty of strong features, but ACDSee Pro is still a long way from the top of the tree

**ACDSEE PRO 8** is a photo management and editing application with similar features to Adobe Lightroom (see *Reviews*, *Shopper* 307). Lightroom is a tough act to follow, though, and although previous versions of ACDSee Pro have shown merit, they haven't done enough to match Adobe's esteemed editor.

Pro 8's photo management is extremely responsive, filtering our 60,000 photos by folder, date, camera or lens model, exposure settings, keyword, rating and a wide range of other metadata in just a few seconds. You don't even have to import the photos: simply browsing to a folder is enough for the software to catalogue its contents.

Sadly, this efficiency only goes so far. The software keeps a list of all the cameras and lenses used in the library, but other metadata can only be filtered according to set values. For example, it will show all photos with a 1/50s or 1/60s shutter speed, but those with a 1/40s or 1/30s shutter fall between the gaps. File types are filtered according to file extension, but there's no provision for Panasonic RAW files, and clicking Sony RAW draws a blank. Various Panasonic and Sony cameras' RAW files are supported but the list is far from up to date,



▲ ACDSee Pro scores highly for colour correction, with the ability to work on limited areas of the frame

with notable omissions such as the Panasonic Lumix DMC-GF6 and Sony A6000. Fujifilm RAW is listed, but support for these files is limited, and none of the X-series cameras from the last couple of years are supported.

ACDSee also lacks lens profiles that compensate for distortions – a feature that an increasing number of compact system cameras and premium compacts rely on for their RAW files. SLRs are well catered for, but it's worth thinking about whether ACDSee Pro is likely to support the next camera you buy.

### RULE OF THUMB

New features in version 8 are distributed throughout and even beyond the interface. PicaView integrates with Windows Explorer's right-click menu to provide a thumbnail and camera metadata for image files, including supported RAW files. It's a great idea and would have been even better if thumbnails were also shown for the files themselves. After reassigning file types to open in ACDSee Pro, files are represented by a generic icon. We also found PicaView temperamental, sometimes making the right-click menu disappear a split second after it had appeared.

SeeDrive is another feature that's better in theory than in practice. It appears as a panel in Manage mode and provides drag-and-drop access to folders in the ACDSee 365 cloud storage service. Navigating online photos was slow, though, with the software locking up for up to 30 seconds as it waited for the server to respond. As 20GB online storage costs £25 per year, there are various other cloud storage services we'd choose over this one.

Double-clicking a thumbnail in Manage mode opens it in View mode. There are two new buttons here for quick treatments. Auto EQ corrects brightness and contrast. It often performed well but some photos looked over-exposed. Auto Lens provides a choice of four filters (Lomo, Orton, Black and White, and Sepia), which are applied to all photos until the Auto Lens setting is reset. Neither the Auto EQ nor the Auto Lens settings are

applied permanently, and they can't be exported. Auto EQ and Black and White are also available in Develop mode, and the other filters are located in Edit mode, under Special Effect, but they're not easy to find.

Develop mode handles non-destructive editing, which is ideal for colour correcting and removing noise from RAW files. Edit mode applies changes destructively to the original file, and concentrates on more creative edits. We've never liked this split as it limits the order in which filters can be applied. However, the destructive tools in Edit mode go further than Lightroom's non-destructive tools with features such as Text design, Tilt-Shift and other creative filters.

### TEST TONE

Edit mode gains a new Pixel Targeting feature, so filters can be applied selectively to parts of the frame depending on the hue or brightness of pixels. You can also target skin tones for inclusion or exclusion. Again, it's a great idea, but the lack of a smoothing or feathering function often resulted in harsh or scrappy edges. We'd prefer to see it in Develop mode, where multiple filters could be used non-destructively and in tandem.

Edit mode also gains a History Window to make it easy to jump back and forth through edits. It's welcome but we're baffled as to why there's still no History panel in Develop mode.

ACDSee Pro 8 is responsive and powerful, and it matches Lightroom for library management and colour correction. Its noise reduction isn't as effective, though, and its camera support is limited. This update doesn't go far enough to catch up with Lightroom.

Ben Pitt



▲ PicaView adds a preview and camera information to the Windows right-click menu

### SPECIFICATIONS

**OS SUPPORT** Windows 7/8  
**MINIMUM CPU** Pentium III  
**MINIMUM GPU** DirectX 9  
**MINIMUM RAM** 512MB  
**HARD DISK SPACE** 310MB  
**DETAILS** [www.acdsee.com](http://www.acdsee.com)

## VIDEO-EDITING SOFTWARE

# MAGIX Movie Edit Pro 2015 Premium



£100 inc VAT • From [www.magix.com](http://www.magix.com)

### VERDICT

**Packed with powerful features, but Magix Movie Edit Pro demands patience**

**HOME VIDEO PRODUCERS** are spoilt for choice, with seven editing packages vying for their business. Movie Edit Pro hasn't been our favourite in the past, but Magix is looking to change that with this latest update.

It's not lacking in features, with 99 tracks that can accommodate any combination of video, audio and graphic files. Ripple-editing options let the user dictate what happens to clips located downstream on the timeline when earlier ones are edited – a valuable feature for complex projects that's notably absent from most consumer editors.

Our chief complaint with previous versions was with the unwieldy interface, so we were delighted to see a redesigned interface listed among the new features. Our excitement was short-lived, though – the redesign appears to be cosmetic, with no change to the sprawling menus and confusingly named features.

Movie Edit Pro is finally an entirely 64-bit application, which bodes well for preview smoothness. However, our hopes were dashed again. The previous version was able to play seven simultaneous 1080p AVCHD streams on our Core i7 870 test PC with 8GB RAM. Loading the same project in Movie Edit Pro 2015, playback began smoothly but stuttered badly about every ten seconds. We had to reduce the number of stacked video streams to five before smooth playback resumed.

As with previous versions, Movie Edit Pro 2015 comes in three editions. The standard version (without a suffix) costs £60. Movie Edit Pro 2015 Plus adds various features



▲ Correction for fish-eye lenses should prove useful for action cam footage

including surround sound, custom disc menu design and 3D video support. There's also a NewBlue Titler EX plug-in for designing 3D titles – a welcome addition but confusingly located under Effects rather than the Title tab.

A multi-camera editing mode, designed for events that were shot with two or more cameras, simplifies the process of synchronising and cutting between them. This mode now supports up to four cameras, which is a significant improvement on the two-camera support introduced in Movie Edit Pro 2013. CyberLink PowerDirector has a similar feature, but we much prefer Magix's implementation because it integrates simply and neatly with the main timeline controls.

### FISH AND CLIPS

The Plus edition also introduces a new effect for removing fish-eye lens distortions. This is particularly useful for GoPro Hero and other action cameras that have fish-eye lenses. The correction is performed manually rather than using profiles for specific lenses, but it worked well for our Hero 3 Black Edition footage. We took the opportunity to test Movie Edit Pro's stabilisation, but it fell short of the upgraded stabilisation in Adobe Premiere Elements (see *Reviews, Shopper 323*).

Another feature that's reserved for the Plus edition is proxy editing. This swaps high-definition video for lower-resolution copies to enable smoother previews, returning to the originals for export. It's extremely valuable for 4K editing or for HD editing on modest hardware. It's just a shame it's not better signposted. This kind of technology should be on by default for 4K footage, or at least offered when importing it.

This isn't the only challenge

facing people who want to edit 4K video.

Although the software automatically matches the project settings to imported media, it's less careful about matching export settings. When exporting to hard disk, you can choose between DVD quality, 720p or 1080p. With no option to customise settings, it looked like 4K exports were impossible. We eventually found a workaround by opting to export at 4K to YouTube, which left a 4K video file in the same folder as our last export to disk. We often complain about other editors' overly complex export options, but this one goes too far the other way. We weren't able to export our 2.7K GoPro footage in MPEG4 format at all, as the drop-down list of Quality settings was mysteriously empty. Exporting as a 1080p MPEG2 file was possible but the video had peculiar letterboxing problems.

Movie Edit Pro 2015 Premium costs £99 including VAT and adds three more plug-ins from Red Giant. Retrograde applies vintage film simulation, Chromatic Glow adds glow effects and Knoll Light Factory adds lens flares. All three are capable of excellent results but they don't integrate well with the host application, presenting their parameters as a text list. They're worth the extra £20, but bear in mind that these extras usually change from one version to the next, so it might be tricky to reopen old projects that use these plug-ins after upgrades and reinstallations.

Movie Edit Pro scores better for quantity than quality, but there's enough here to keep it in the running, such as its ripple-editing options, 99 tracks and accomplished multi-cam editing. It's a solid choice for those who don't mind putting up with a few quirks.

**Ben Pitt**



▲ Multicam mode now supports up to four video streams

### SPECIFICATIONS

**OS SUPPORT** Windows 7/8/8.1  
**MINIMUM CPU** Dual-core 2.4GHz (Quad 2.8GHz for HD)  
**MINIMUM GPU** 512MB for HD  
**MINIMUM RAM** 1GB (4GB for HD)  
**HARD DISK SPACE** 2GB  
**DETAILS** [www.magix.com](http://www.magix.com)



FRONTIER  
DEVELOPMENTS

## Elite: Dangerous

£40 inc VAT • From [www.elitedangerous.com](http://www.elitedangerous.com)

## VERDICT

A game of boundless ambition and scope but precious little fun

**SPACE. THE VAST,** empty vacuum. The final frontier. Anything could happen out there. There are endless ways to meet your end, but by far the most common? Boredom. Elite Dangerous is the first game we've played in a long time capable of boring you to death.

It all starts off so **promisingly**. This is the first Elite game since 1995's ambitious but flawed First Encounters and, backed by Kickstarter cash, promises to let you live your dreams of being a spacefaring commander in a limitless galaxy. An entertaining sequence of training missions takes you through the basics of space flight and combat, and by the end you're itching to stock up on multicannon ammo and live the kind of adventure only an infinite universe can provide.

How your career unfolds is up to you. You can be a trader, courier, mercenary, miner or pirate, among other things. Land at a space station, fish through the bulletin board for courier missions, assassinations or requests to source rare materials, and take off into the great beyond in search of thrills and profit.

And that's where it all grinds to a halt.

Assassinations and mercenary work are beyond your ship's modest capabilities at first, so you'll have to stick with courier missions and trading, but this isn't much fun. Your exciting courier job to destabilise the government of Zeta Lupi essentially boils



↑ You'll spend a lot of time flying through empty space on your way to the next trading post or mission

down to performing a quick frame shift drive jump, then taking your hands off the controls in Supercruise and watching the distance to your next spaceport count down until you can safely disengage. You then ask for permission to land and carefully dock your ship. After this you consult the bulletin board to find another mission, or stock up on goods to trade, plot your course on the Galaxy Map and take off. The brief excitement of the jump to faster-than-light speeds is once again overshadowed by the long slog across the next solar system.

Elite: Dangerous also insists that you do most things **manually**. You have to manage your frame drive speed carefully to strike a balance between spending 10 minutes flying through endless empty space, or wildly overshooting your target. Once close enough you can use Safe Disengage to drop in around 1km from a space station, but you then have to go through the rigmarole of landing.

## CAPITAL PUNISHMENT

This would be less of a problem if making money weren't so hard. We started off trying to trade, but only made around a thousand credits per run. With all the flying, taking off and landing, this takes the best part of 20 minutes, and a good third of your profit is swallowed up in fuel costs.

Switching to bulletin board missions improved matters, but you'll never get rich delivering messages for 700 credits a pop. We started in the default Sidewinder ship, but after several hours trying to make decent cash we gave up and started a new game with a larger Cobra MK III. Even then it took four hours of shuttle runs, without even a pirate attack to liven things up, to scrape together 10,000 credits.

There are big scores to be found. We were offered a career-changing 45,000 credits – enough to buy a Frame Shift Drive Interdictor to pull other ships out of Supercruise to indulge in some good

old-fashioned piracy. Sadly, this required 20,000 credits' worth of aluminium, and to accumulate the necessary capital would have taken another four hours of grinding.

We were happy to put in the effort, but real life kept getting in the way. Missions are all time-limited, and the game's clock is in real-time. Even in Solo mode, where you don't have to deal with human players clogging up the landing pads, the game connects to the Elite servers (you're booted out of the game if the connection is lost), and the universe continues as you left it. If you take on a lucrative job with what you think is plenty of time, but then have to answer the phone or drive to the shops, by the time you get back you don't have enough time to complete it. This not only damages your reputation, but in many cases you get slapped with a fine.

## EXTRACTOR PLAN

Some missions seem pointlessly hard, too. In one we needed to find some mineral extractors and deliver them to a starport for a fat reward. We headed out to a system with an economy based entirely around mining, but there were no mineral extractors for sale. We could have tried another system, but that would have taken another 20 minutes and it was time for bed. Mission failed.

This is a shame, as Elite: Dangerous has plenty to admire. Space stations look spectacular as you swoop around them, and cockpit designs are impressive, with your displays flickering into life as you look around. The sound design is also rather special, particularly the roar of your engines as you accelerate, and the cockpit shaking in reaction to your frame shift drive's **power**.

Unfortunately, none of this is enough to give Dangerous what it lacks: fun. Some say the title really opens up after the first 100,000 credits, but based on our progress that would require around 40 hours of relentless grind and, for us at least, life is simply too short.

Chris Finnamore



↓ The highly manoeuvrable Eagle Mk. II is the first proper combat ship you unlock – but it's expensive

## SPECIFICATIONS

## AVAILABLE FORMATS PC

OS SUPPORT Windows 7, Windows 8.1 64-bit

MINIMUM CPU 2.0GHz quad-core Intel/AMD

MINIMUM GPU Nvidia GeForce GTX 260/AMD Radeon 4870HD

MINIMUM RAM 4GB

HARD DISK SPACE 5GB+

DETAILS [www.elitedangerous.com](http://www.elitedangerous.com)

PRODUCT CODE Elite Dangerous



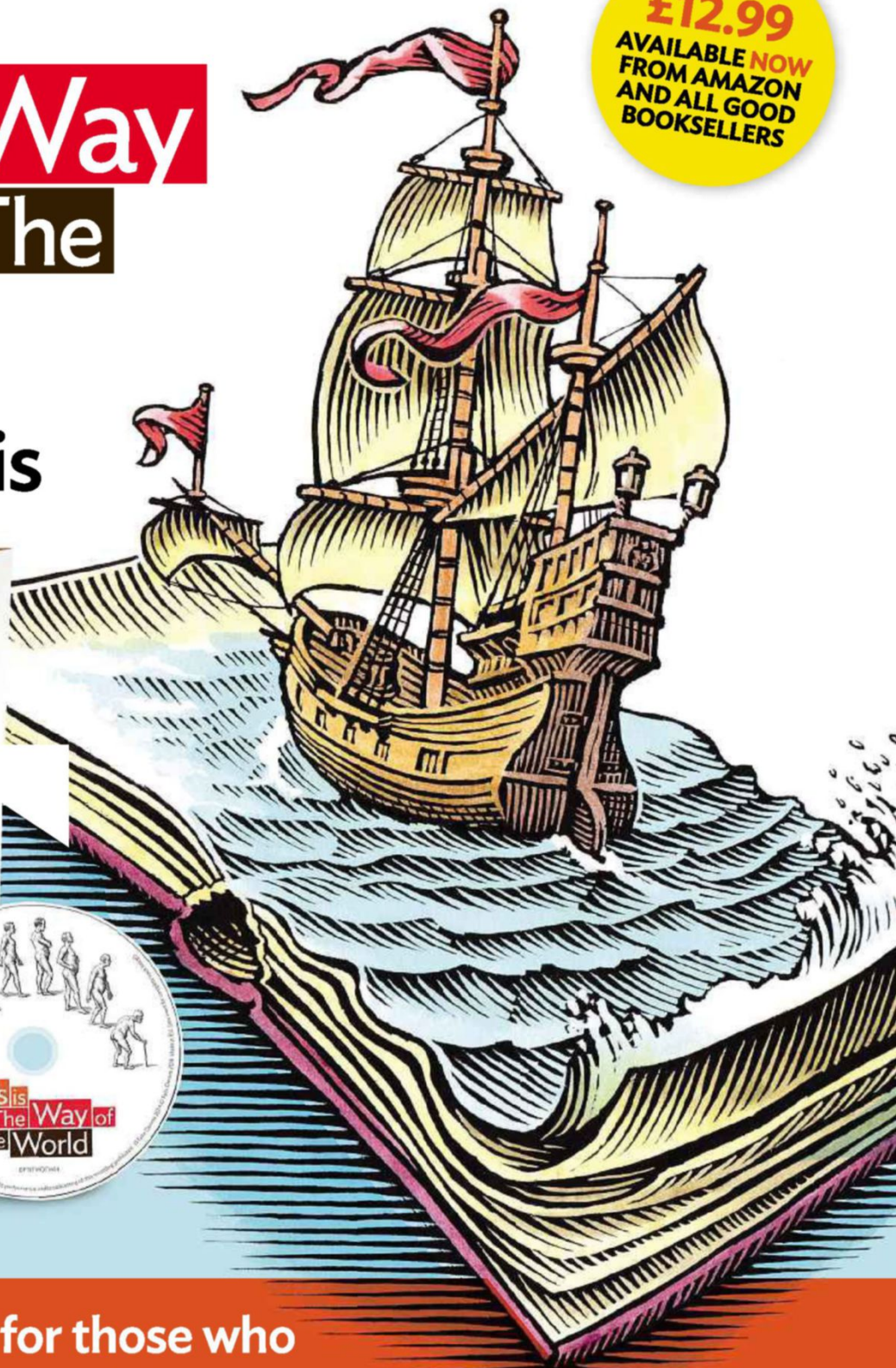
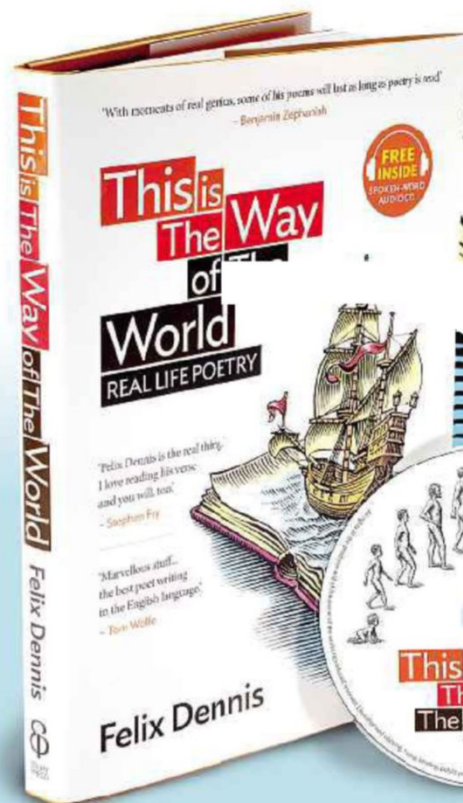
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– Benjamin Zephaniah

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[www.felixdennis.com](http://www.felixdennis.com) contains many poems, published and unpublished, as well as a library of sound recordings and video footage of Felix Dennis's verse and poetry tours.



## Choosing a...

### Laptop computer

**01** A basic laptop costing around £300 will run everyday office, multimedia and education software, but it won't be suitable for 3D gaming. Many laptops at this price have a 15.4in case and weigh around 2.4kg, so they're best used around the house and for occasional journeys.

**02** If you want to play modern games, you'll need a laptop that has a dedicated graphics chip such as the AMD Radeon HD 7970M. Good gaming laptops tend to have large 17in screens and weigh around 3kg, so they're best suited to the home.

**03** If you want a laptop that you can take everywhere, look for a model that weighs less than 2kg. For the best portability, look for one with an 11in or 13in screen. In general, the smaller and lighter the laptop, the more expensive it is. Intel Ultrabooks are highly portable, but expect to pay upwards of £600 for a good one.

**04** Battery life is extremely important for a laptop. We'd expect all but the biggest and heaviest to last for at least five hours on a single charge, but for an ultra-portable that you carry everywhere, eight hours and above is more desirable.

**05** Laptops use the mobile versions of processors to conserve power, and these lag behind desktop chips for performance. For a budget laptop, an Intel Core i3 processor will do the job, but if you want better performance, look for an Intel Core i5 or Core i7 model instead. We recommend a minimum of 4GB of RAM, although 8GB is better for multitasking.

**06** Most budget and mid-range laptops have a regular hard disk for storage. You want at least 500GB, but 1TB or more is better. SSDs have faster performance, making your computer much faster to boot. SSD capacity is lower, though, and you'll need at least 128GB.

**07** Netbooks are a type of small, low-cost ultra-portable laptop. They're fine for light use, but avoid them if you want to do complicated tasks.

### PCs



#### CHILLBLAST Fusion Ares



£1,400 inc VAT • [www.chillblast.com](http://www.chillblast.com)

This achingly pretty Chillblast system uses an overclocked, liquid-cooled six-core Intel Core i7-5820K processor and a 2GB Radeon R9 285 X-Edition graphics card to make a powerful workstation and Full HD gaming PC.

**PROCESSOR** Six-core 4.2GHz Intel Core i7-5820K • **RAM** 16GB • **FRONT USB PORTS** 4 • **REAR USB PORTS** 10 • **TOTAL STORAGE** 250GB SSD, 2TB hard disk • **GRAPHICS CARD** 2GB VTXSD Radeon R9 285 X-Edition • **DISPLAY** None • **OPERATING SYSTEM** Windows 8.1 • **WARRANTY** Five years (three years collect and return, two years RTB) • **DETAILS** [www.chillblast.com](http://www.chillblast.com) • **PART CODE** Fusion Ares • **FULL REVIEW** Jan 2015



#### APPLE Mac Mini (2014)



£569 inc VAT • [store.apple.com/uk](http://store.apple.com/uk)

The Mac Mini (2014) has great performance for a compact system. It has stunning looks thanks to its beautiful curved edges made from a single block of aluminium. A worthy update to the Mac Mini range and a good choice for those looking for their first Apple Mac computer.

**PROCESSOR** Dual-core 2.6GHz Intel Core i5-4278U • **RAM** 8GB • **FRONT USB PORTS** 0 • **REAR USB PORTS** 4 • **TOTAL STORAGE** 1TB hard disk • **DISPLAY** None • **OPERATING SYSTEM** Mac OS X 10.10 • **WARRANTY** One year RTB • **DETAILS** [www.apple.com](http://www.apple.com) • **PART CODE** Mac Mini A1357 • **FULL REVIEW** Feb 2015



#### PALICOMP AMD Kaveri Evolution



£500 inc VAT • [www.palicmp.co.uk](http://www.palicmp.co.uk)

Palicomp has really pushed the boundaries of what you can expect from a budget PC. We were particularly impressed by the AMD Kaveri Evolution's high-quality 24in monitor and 720p gaming performance.

**PROCESSOR** 4GHz AMD A10-7700K • **RAM** 8GB • **FRONT USB PORTS** 3 • **REAR USB PORTS** 4 • **TOTAL STORAGE** 1TB SSHD • **DISPLAY** 24in widescreen LCD • **OPERATING SYSTEM** Windows 8.1 • **WARRANTY** Three years RTB • **PART CODE** KAVI • **DETAILS** [www.palicmp.co.uk](http://www.palicmp.co.uk) • **FULL REVIEW** Sep 2014



### LAPTOPS



#### DELL Inspiron 15 5000



£479 inc VAT • [www.dell.com/uk](http://www.dell.com/uk)

Dell has somehow managed to squeeze a good Intel Core i7 processor and dedicated graphics processor into a sub-£500 laptop, making the Inspiron 15 5000 a brilliant all-rounder and a worthy Best Buy.

**PROCESSOR** Dual-core 2GHz Intel Core i7-4510U • **RAM** 8GB • **DIMENSIONS** 380x259x22mm • **WEIGHT** 2.4kg • **SCREEN SIZE** 15.6in • **SCREEN RESOLUTION** 1,366x768 • **GRAPHICS ADAPTOR** AMD Radeon HD R7 M265 • **TOTAL STORAGE** 1TB hard disk • **OPERATING SYSTEM** Windows 8.1 • **WARRANTY** One year collect and return • **PART CODE** Inspiron-15-5547 • **DETAILS** [www.dell.com/uk](http://www.dell.com/uk) • **FULL REVIEW** Nov 2014



For more laptops, see the Group Test on page 78



#### ASUS EeeBook X205TA



£180 inc VAT • [www.pcworld.co.uk](http://www.pcworld.co.uk)

Asus's answer to the Chromebook is a resounding success. It's not the most powerful laptop in the world and its on-board storage is tiny, but in return you get a supremely light laptop and a year of Office365 worth £60. Perfect for light users who use their laptop for document editing.

**PROCESSOR** Quad-core 1.33GHz Intel Atom Z3735F • **RAM** 2GB • **SIZE** 286x193x18mm • **WEIGHT** 380g • **SCREEN SIZE** 11.6in • **SCREEN RESOLUTION** 1,366x768 • **GRAPHICS ADAPTOR** Intel HD Graphics • **TOTAL STORAGE** 32GB eMMC • **OPERATING SYSTEM** Windows 8.1 with Bing • **WARRANTY** One year collect and return • **DETAILS** [www.asus.com](http://www.asus.com) • **PART NUMBER** X205TA-BING-FD15BS • **FULL REVIEW** Mar 2015



#### MSI GS70 2QE Stealth Pro



£1,300 inc VAT • [www.currys.co.uk](http://www.currys.co.uk)

MSI's thin gaming laptop is the first gaming machine we've seen running Nvidia's latest 900M-series graphics hardware. The step up in performance is huge and, if you've got the cash, it's well worth investing in because the boost you get in the latest games is significant. Not only that, the chassis is nicely built and the screen's decent too. It's a good all-round package.

**PROCESSOR** Quad-core 2.5GHz Intel Core i7-4710HQ • **RAM** 16GB • **SIZE** 419x287x22mm • **WEIGHT** 2.7kg • **SCREEN SIZE** 17.6in • **SCREEN RESOLUTION** 1,920x1,080 • **GRAPHICS ADAPTOR** Nvidia GeForce GTX 970M • **TOTAL STORAGE** 128GB SSD, 1TB hard disk • **OPERATING SYSTEM** Windows 8.1 • **WARRANTY** Two years collect and return • **DETAILS** [www.msi.com](http://www.msi.com) • **PART NUMBER** 957-177314-033 • **FULL REVIEW** Feb 2015



## SMARTPHONES



### SAMSUNG Galaxy S5

★★★★★

£398 inc VAT SIM-free, free on £26.50-per-month contract • [www.handtec.co.uk](http://www.handtec.co.uk) (SIM-free), [www.carphonewarehouse.com](http://www.carphonewarehouse.com) (contract)

The Galaxy S5 is a great choice if you're looking to replace an old handset. Its outstanding battery life will keep you going all day long and its performance in our benchmarks is among the best we've seen.

PROCESSOR Quad-core 2.5GHz Qualcomm Snapdragon 801 • SCREEN SIZE 5.1in • SCREEN RESOLUTION 1,920x1,080 • REAR CAMERA 16 megapixels • STORAGE 16GB • WIRELESS DATA 4G • DIMENSIONS 142x73x8mm • WEIGHT 145g • OPERATING SYSTEM Android 4.4 • PART CODE SM-G900H • DETAILS [www.samsung.co.uk](http://www.samsung.co.uk) • FULL REVIEW Jul 2014



### SONY Xperia Z3 Compact

★★★★★

£360 inc VAT SIM-free, free on £22.50-per-month contract • [www.handtec.co.uk](http://www.handtec.co.uk) (SIM-free), [www.carphonewarehouse.com](http://www.carphonewarehouse.com) (contract)

With its incredible 20-hour battery life and fast performance, the Sony Xperia Z3 Compact brings flagship features to a smaller handset at a great price.

PROCESSOR Quad-core 2.5GHz Qualcomm Snapdragon 801 • SCREEN SIZE 4.6in • SCREEN RESOLUTION 1,280x720 • REAR CAMERA 20.7 megapixels • STORAGE 16GB • WIRELESS DATA 4G • DIMENSIONS 127x65x8.6mm • WEIGHT 129g • OPERATING SYSTEM Android 4.4 • PART CODE Sony D5803 • DETAILS [www.sony.co.uk](http://www.sony.co.uk) • FULL REVIEW Jan 2015



### HTC Desire Eye

★★★★★

£399 inc VAT Pre-pay, £29 on £27-per-month contract • [www.three.co.uk](http://www.three.co.uk) (Pre-pay & contract)

With its two 13-megapixel cameras, the Desire Eye is great for photography and selfie fans alike. It has quick internals to match HTC's flagship One (m8), and the bright, dual-colour unibody design looks great too.

PROCESSOR Quad-core 2.3GHz Qualcomm Snapdragon 801 • SCREEN SIZE 5.2in • SCREEN RESOLUTION 1,920x1,080 • REAR CAMERA 13 megapixels • STORAGE 16GB • WIRELESS DATA 4G • SIZE 152x74x8.5mm • WEIGHT 154g • OPERATING SYSTEM Android 4.4 • DETAILS [www.htc.com](http://www.htc.com) • PART CODE Desire Eye • FULL REVIEW Mar 2015



### MOTOROLA Moto G (2nd Gen)

★★★★★

£143 inc VAT SIM-free, free on £14-per-month contract • [www.handtec.co.uk](http://www.handtec.co.uk) (SIM-free), [www.mobilephonesdirect.co.uk](http://www.mobilephonesdirect.co.uk) (contract)

The Moto G just got even better. Now available with a larger screen, better camera and longer battery life, the new Moto G is the best budget smartphone available.

PROCESSOR Quad-core 1.2GHz Qualcomm Snapdragon 400 • SCREEN SIZE 5in • SCREEN RESOLUTION 1,280x720 • REAR CAMERA 8 megapixels • STORAGE 8GB • WIRELESS DATA 3G • DIMENSIONS 141x70x11mm • WEIGHT 149g • OPERATING SYSTEM Android 4.4 • PART CODE XT1068 • DETAILS [www.motorola.co.uk](http://www.motorola.co.uk) • FULL REVIEW Jan 2015



### NOKIA Lumia 930

★★★★★

£350 inc VAT SIM-free, free on £26.50-per-month contract • [www.ebuyer.com](http://www.ebuyer.com) (SIM-free), [www.carphonewarehouse.com](http://www.carphonewarehouse.com) (contract)

The Lumia 930 benefits from a fantastic Full HD OLED screen, excellent performance and beautiful Nokia build quality. It also runs Windows Phone 8.1, which brings several improvements to the operating system.

PROCESSOR Quad-core 2.2GHz Qualcomm Snapdragon 800 • SCREEN SIZE 5in • SCREEN RESOLUTION 1,920x1,080 • REAR CAMERA 20 megapixels • STORAGE 32GB • WIRELESS DATA 4G • DIMENSIONS 137x71x9.8mm • WEIGHT 167g • OPERATING SYSTEM Windows Phone 8.1 • PART CODE RM-1045 • DETAILS [www.nokia.com](http://www.nokia.com) • FULL REVIEW Oct 2014



## TABLETS



### SAMSUNG Galaxy Tab S 8.4

★★★★★

£275 inc VAT • [www.expansys.com](http://www.expansys.com)

The Galaxy Tab S 8.4 is a fast, compact tablet with an astonishing high-resolution screen. It's similar in price to the iPad Mini, but if screen quality is more important than app selection, this is the model to buy.

PROCESSOR Quad-core 1.9GHz Samsung Exynos 5 Octa (+quad-core 1.3GHz) • SCREEN SIZE 8.4in • SCREEN RESOLUTION 2,560x1,600 • REAR CAMERA 8 megapixels • STORAGE 16GB • WIRELESS DATA 4G (optional) • DIMENSIONS 213x126x6.6mm • WEIGHT 294g • OPERATING SYSTEM Android 4.4 (KitKat) • WARRANTY One year RTB • PART CODE N107639 • DETAILS [www.samsung.com/uk](http://www.samsung.com/uk) • FULL REVIEW Oct 2014



### GOOGLE Nexus 9

★★★★★

£319 inc VAT • [play.google.com](http://play.google.com)

The Nexus 9 is the first Google-branded tablet to have an iPad-style 4:3 ratio screen, which we think is a better shape for web browsing. Android 5.0 Lollipop runs beautifully and its battery life is superb.

PROCESSOR Dual-core 2.3GHz 64-bit Nvidia Tegra K1 Denver • SCREEN SIZE 8.9in • SCREEN RESOLUTION 2,048x1,536 • REAR CAMERA 8 megapixels • STORAGE 16GB • WIRELESS DATA 4G (optional) • DIMENSIONS 154x228x8mm • WEIGHT 425g • OPERATING SYSTEM Android 5.0 • WARRANTY One year RTB • PART CODE Nexus 9 • DETAILS [www.google.com/nexus/9](http://www.google.com/nexus/9) • FULL REVIEW Feb 2015



### APPLE iPad Air 2

★★★★★

£399 inc VAT • [store.apple.com/uk](http://store.apple.com/uk)

The iPad Air 2 is even thinner and lighter than its predecessor and still feels beautifully made. It's the fastest iPad yet, and now has TouchID fingerprint recognition for added security. It's still the tablet to beat.

PROCESSOR Tri-core 1.5GHz Apple A8X • SCREEN SIZE 9.7in • SCREEN RESOLUTION 2,048x1,536 • REAR CAMERA 8 megapixels • STORAGE 16GB • WIRELESS DATA 4G (optional) • DIMENSIONS 240x170x6.1mm • WEIGHT 437g • OPERATING SYSTEM iOS 8.1 • WARRANTY One year RTB • PART CODE Apple iPad Air 2 • DETAILS [www.apple.com/uk](http://www.apple.com/uk) • FULL REVIEW Feb 2015



### MICROSOFT Surface Pro 3

★★★★★

£849 inc VAT • [www.microsoftstore.com](http://www.microsoftstore.com)

If you want the best of both laptop and tablet worlds, the Surface Pro 3 is the device to buy. It has a beautiful high-res screen, an innovative stylus and the ability to run proper Windows applications. It's expensive, but this piece of kit can do it all.

PROCESSOR Dual-core 1.9GHz Intel Core i5-4300U • SCREEN SIZE 12in • SCREEN RESOLUTION 2,160x1,440 • REAR CAMERA 5 megapixels • STORAGE 128GB • WIRELESS DATA None • DIMENSIONS 292x201x9mm • WEIGHT 800g • OPERATING SYSTEM Windows 8.1 Pro • WARRANTY One year RTB • PART CODE Surface Pro 3 • DETAILS [www.microsoft.com](http://www.microsoft.com) • FULL REVIEW Nov 2014



### TESCO Hudl 2

★★★★★

£129 inc VAT • [www.tesco.com/direct/hudl](http://www.tesco.com/direct/hudl)

The Hudl 2 is even better value than the original. It has a great screen, good build quality and runs Android smoothly. Battery life isn't great, but otherwise this is a fantastic complete budget tablet.

PROCESSOR Quad-core 1.3GHz Intel Atom Z3735D • SCREEN SIZE 8.3in • SCREEN RESOLUTION 1,920x1,200 • REAR CAMERA 5 megapixels • STORAGE 16GB • WIRELESS DATA None • DIMENSIONS 224x128x9mm • WEIGHT 410g • OPERATING SYSTEM Android 4.4.2 • WARRANTY One year RTB • PART CODE hudl2 • DETAILS [www.tesco.com/direct/hudl](http://www.tesco.com/direct/hudl) • FULL REVIEW Jan 2015



## Choosing a ... Smartphone

**01** A smartphone's operating system (OS) dictates its basic features and which third-party software you can install. There are three main contenders: Apple's iOS, which is found on the iPhone; Google's Android, which is used by various handset manufacturers; and Windows Phone 8, which is becoming more widespread and is a great alternative to Apple's and Google's operating systems. Apple iOS and Google Android have the most apps available but Windows Phone is slowly catching up.

**02** All smartphones have colour screens, but their resolutions vary. Basic models have 800x480 pixels, but text can be indistinct. Look for a display that has at least 1,280x720 pixels so that it's easy to browse web pages on your smartphone. Don't worry too much about built-in media players or Office document editors – you can always install apps to replace these with better versions later.

Cameras are common in smartphones, and resolutions have increased to as high as 20 megapixels. The image quality of smartphone cameras has improved tremendously in recent years.

**03** Nearly all smartphones have touchscreen interfaces, and some have a physical keyboard for entering text quickly and accurately. Although a physical keyboard can aid heavy emailing, touchscreen keyboards work well too. Android smartphones and iPhones running iOS 8 let you install a variety of custom onscreen keyboards so you can find one that suits you.

**04** Be careful when choosing a mobile contract. Look for one with a large data allowance if you want to use the internet regularly or you've set your phone to synchronise your contacts, calendar and email through online services such as Google's. Built-in Wi-Fi can help you avoid high data charges by connecting to the internet through wireless hotspots when you're out, or your router when you're at home. Android and iPhone handsets can operate as wireless hotspots, enabling you to connect your laptop to the internet over your mobile data connection. There may be an extra charge for this.



# Choosing a ...

## Monitor

**01** A basic 24in LCD monitor costs around £100. It will be fine for typical Windows work but is likely to have poor viewing angles, so you'll need to sit straight on to achieve the best picture quality. Its colour accuracy may not be very good, though.

**02** A VGA input lets you use the monitor with any PC, but the quality may not be as good as it is over DVI or HDMI. Both are digital connections and require a compatible graphics card but they avoid the need for digital-to-analogue or analogue-to-digital conversions, which can reduce image quality. A digital connection achieves the best picture automatically, so you won't have to adjust clock or phase settings as you do with analogue connections.

Many DVI and all HDMI connections support HDCP, which lets you watch protected video content, such as Blu-ray movies. DisplayPort is becoming more popular, but you'll need a graphics card with a DisplayPort output (mini or full-size) to use this input on your monitor.

**03** A larger monitor will be easier on the eye and may have a higher resolution. Most monitors have resolutions of at least 1,920x1,080 (1080p), which provide lots of room for working with multiple windows at the same time. For even higher resolutions, you'll need a larger display. Some 27in and 30in screens have a massive 2,560x1,600 resolution. You'll need a graphics card with a dual-link DVI output and a dual-link DVI cable or either HDMI or DisplayPort to use a monitor at this resolution.

**04** If you want better picture quality, look for a monitor with a high contrast ratio. The higher the ratio, the whiter the whites and the blacker the blacks. You'll also be able to see more fine detail in images with high contrast levels. Viewing angles are important, as wider angles mean you don't have to sit directly in front of the monitor to get the best picture. Wider viewing angles also allow more people to view the screen at the same time.

Fast response times reduce ghosting, but don't be dazzled by the numbers. A response time of 25ms or quicker is fine for all applications.

## PHOTOGRAPHY

COMPACT SYSTEM CAMERA	<b>COMPUTER SHOPPER</b> <b>RECOMMENDED</b> ★★★★★ <b>SAMSUNG NX3000</b> <b>£220 inc VAT • www.argos.co.uk</b> With its high image quality, wealth of features and slim design, the NX3000 is an excellent camera. Better still, at its current low price it's an unbelievable bargain. Buy one while you can. <b>SENSOR RESOLUTION</b> 20 megapixels • <b>SENSOR SIZE</b> 23.5x15.7mm (APS-C) • <b>FOCAL LENGTH MULTIPLIER</b> 1.5x • <b>VIEWFINDER</b> None • <b>LCD SCREEN</b> 3in (460,800 dots) • <b>OPTICAL ZOOM (35MM-EQUIVALENT FOCAL LENGTHS)</b> 3.1x (24-75mm) • <b>35MM-EQUIVALENT APERTURE</b> f/5.2-8.4 • <b>LENS MOUNT</b> Samsung NX • <b>WEIGHT</b> 386g • <b>DIMENSIONS</b> 61x26x78mm • <b>WARRANTY</b> One year RTB • <b>DETAILS</b> www.samsung.com/uk • <b>FULL REVIEW</b> Jan 2015	
COMPACT CAMERA	<b>COMPUTER SHOPPER</b> <b>BEST BUY</b> ★★★★★ <b>NIKON Coolpix S9700</b> <b>£169 inc VAT • www.ukdigitalcameras.co.uk</b> This compact camera packs in a 30x zoom lens, Wi-Fi, GPS and slow-motion video. Its has a comprehensive set of controls, but it's the image quality that really impresses, achieving decent shots in tough conditions. <b>SENSOR RESOLUTION</b> 16 megapixels • <b>SENSOR SIZE</b> 1/2.3in • <b>VIEWFINDER</b> None • <b>LCD SCREEN</b> 3in (921,000 dots) • <b>OPTICAL ZOOM (35MM-EQUIVALENT FOCAL LENGTHS)</b> 30x (25-750mm) • <b>35MM-EQUIVALENT APERTURE</b> f/21-36 • <b>WEIGHT</b> 235g • <b>DIMENSIONS</b> 66x110x34mm • <b>WARRANTY</b> Two years RTB • <b>DETAILS</b> www.nikon.co.uk • <b>FULL REVIEW</b> Nov 2014	
ULTRA-ZOOM CAMERA	<b>COMPUTER SHOPPER</b> <b>BEST BUY</b> ★★★★★ <b>PANASONIC Lumix DMC-FZ200</b> <b>£339 inc VAT • www.johnlewis.com</b> This ultra-zoom camera has a big 25-600mm zoom range and maintains a fast F2.8 aperture across the whole focal range, so you can shoot in low-light conditions without too much worry. <b>SENSOR RESOLUTION</b> 12.1 megapixels • <b>SENSOR SIZE</b> 6.2x4.6mm (1/2.3in) • <b>VIEWFINDER</b> Electronic • <b>LCD SCREEN</b> 3in • <b>OPTICAL ZOOM (35MM-EQUIVALENT FOCAL LENGTHS)</b> 25-600mm • <b>35MM-EQUIVALENT APERTURE</b> f/2.8 • <b>WEIGHT</b> 588g • <b>DIMENSIONS</b> 87x125x110mm • <b>WARRANTY</b> One year RTB • <b>DETAILS</b> www.panasonic.com/uk • <b>FULL REVIEW</b> Feb 2013	
SLR CAMERA	<b>COMPUTER SHOPPER</b> <b>BEST BUY</b> ★★★★★ <b>NIKON D7100</b> <b>£899 inc VAT • www.wexphotographic.com</b> The Nikon D7100 provides class-leading image quality, exceptional ergonomics and a sophisticated autofocus system. If you love photography, you'll love the Nikon D7100. This kit comes with the 18-105mm VR lens. <b>SENSOR RESOLUTION</b> 24 megapixels • <b>SENSOR SIZE</b> 23.5x15.6mm (APS-C) • <b>FOCAL LENGTH MULTIPLIER</b> 1.52x • <b>VIEWFINDER</b> Optical • <b>LCD SCREEN</b> 3.2in • <b>OPTICAL ZOOM (35MM-EQUIVALENT FOCAL LENGTHS)</b> 27-157mm • <b>35MM-EQUIVALENT APERTURE</b> f/4 • <b>LENS MOUNT</b> F-mount • <b>WEIGHT</b> 1.2kg • <b>DIMENSIONS</b> 108x137x160mm • <b>WARRANTY</b> Two years RTB • <b>DETAILS</b> www.nikon.co.uk • <b>FULL REVIEW</b> Oct 2013	
SLR CAMERA	<b>COMPUTER SHOPPER</b> <b>BEST BUY</b> ★★★★★ <b>CANON EOS 700D</b> <b>£539 inc VAT • www.wexphotographic.com</b> This superb all-rounder avoids the flaws of its predecessors. Photos taken with its 18-55mm kit lens were consistently better than those of similarly priced cameras, and there's a wide range of affordable extra lenses. <b>SENSOR RESOLUTION</b> 20 megapixels • <b>SENSOR SIZE</b> 22.5x15mm (APS-C) • <b>FOCAL LENGTH MULTIPLIER</b> 1.62x • <b>VIEWFINDER</b> Optical • <b>LCD SCREEN</b> 3in • <b>OPTICAL ZOOM (35MM-EQUIVALENT FOCAL LENGTHS)</b> 27-82.5mm (kit lens) • <b>35MM-EQUIVALENT APERTURE</b> f/4 • <b>LENS MOUNT</b> EF-mount • <b>WEIGHT</b> 755g (body only) • <b>DIMENSIONS</b> 104x139x79mm • <b>WARRANTY</b> One year RTB • <b>DETAILS</b> www.canon.co.uk • <b>FULL REVIEW</b> Nov 2013	

## DISPLAYS

MONITOR	<b>COMPUTER SHOPPER</b> <b>BEST BUY</b> ★★★★★ <b>BENQ GW2765HT</b> <b>£282 inc VAT • www.ballicom.co.uk</b> This 27in 2,560x1,440 IPS monitor is one of the best-value screens we've ever seen. With near-perfect sRGB colour accuracy out of the box, it's a steal for less than £300. <b>SCREEN SIZE</b> 27in • <b>RESOLUTION</b> 2,560x1,440 • <b>SCREEN TECHNOLOGY</b> IPS • <b>VIDEO INPUTS</b> VGA, DVI, HDMI, DisplayPort • <b>WARRANTY</b> Two years onsite • <b>PART CODE</b> G2765HT • <b>DETAILS</b> www.benq.co.uk • <b>FULL REVIEW</b> Jan 2015	
MONITOR	<b>COMPUTER SHOPPER</b> <b>RECOMMENDED</b> ★★★★★ <b>VIEWSONIC VX2363Smhl-W</b> <b>£128 inc VAT • www.lambda-tek.com</b> The 23in VX3263Smhl-W stands out from the crowd with its white stand, IPS screen and great overall image quality. It's a good budget buy for those who have modest needs. <b>SCREEN SIZE</b> 23in • <b>RESOLUTION</b> 1,920x1,080 • <b>SCREEN TECHNOLOGY</b> IPS • <b>VIDEO INPUTS</b> VGA, DVI, HDMI, MHL-compatible HDMI • <b>WARRANTY</b> Two years collect and return • <b>PART CODE</b> VX2363Smhl-W • <b>DETAILS</b> www.viewsoniceurope.com • <b>FULL REVIEW</b> Jan 2015	
MONITOR	<b>COMPUTER SHOPPER</b> <b>BEST BUY</b> ★★★★★ <b>IYAMA ProLite GB2488HSU-B1</b> <b>£206 inc VAT • www.scan.co.uk</b> Gamers need look no further than the Iiyama ProLite GB2488HSU-B1. It's a no-nonsense Full HD panel with a 144Hz refresh rate for lightning-fast games. This display is great value. <b>SCREEN SIZE</b> 24in • <b>RESOLUTION</b> 1,920x1,080 • <b>SCREEN TECHNOLOGY</b> TN • <b>VIDEO INPUTS</b> 2x HDMI, DVI, DisplayPort • <b>WARRANTY</b> Two years onsite • <b>PART CODE</b> ProLite GB2488HSU-B1 • <b>DETAILS</b> www.iiyama.com • <b>FULL REVIEW</b> Aug 2014	
PROJECTOR	<b>COMPUTER SHOPPER</b> <b>RECOMMENDED</b> ★★★★★ <b>OPTOMA GT1080</b> <b>£580 inc VAT • www.projectorplanet.co.uk</b> Optoma's short-throw gaming projector can produce 100in images from just a metre away. This, combined with excellent image quality, versatile colour presets and portability, makes it a great buy for any gaming den. <b>PROJECTOR TYPE</b> Single-chip DLP • <b>NATIVE RESOLUTION</b> 1,920x1,080 • <b>VIDEO INPUTS</b> 2x HDMI (1x MHL) • <b>LAMP LIFE</b> 5,000h • <b>LAMP BRIGHTNESS</b> 2,800 Lumens • <b>DIMENSIONS</b> 114x315x224mm • <b>WEIGHT</b> 2.7kg • <b>WARRANTY</b> Two years RTB • <b>PART CODE</b> GT1080 • <b>DETAILS</b> www.optoma.co.uk • <b>FULL REVIEW</b> Nov 2014	
MONITOR	<b>COMPUTER SHOPPER</b> <b>BEST BUY</b> ★★★★★ <b>SAMSUNG S32D850T</b> <b>£435 inc VAT • www.laptopsdirect.co.uk</b> It's not cheap, but this 32in monitor is great value. Images are sharp and vibrant on its 2,560x1,440 panel, and the stand is among the most attractive we've seen. <b>SCREEN SIZE</b> 32in • <b>RESOLUTION</b> 2,560x1,440 • <b>SCREEN TECHNOLOGY</b> VA • <b>VIDEO INPUTS</b> HDMI, DVI, DisplayPort • <b>WARRANTY</b> Two years collect and return • <b>PART CODE</b> S32D850T • <b>DETAILS</b> www.samsung.com/uk • <b>FULL REVIEW</b> Jan 2015	

# Choosing an ...

## HD TV

**01** A 32in Full HD TV costs around £290 and will suit smaller living rooms. TVs look much smaller in the shop than in your home, so measure the space available before you buy.

**02** A 1,920x1,080-resolution TV can display a 1080p image. You can still buy TVs with a 720p (1,366x768) resolution, but they're no cheaper and the image won't be as sharp. Even so, it can be difficult to tell the difference between 720p and 1080p on smaller screens.

**03** Consider the number of inputs you need for your equipment. Two HDMI ports should be the minimum, but many TVs come with four. Don't forget devices such as games consoles and PVRs. If you have older equipment, check that your TV has enough SCART and component sockets.

If you want to plug your PC into your TV, you'll need to use either HDMI or VGA inputs. Be aware that some TVs only let you use a PC on an analogue input, and others won't display the Windows desktop at the TV's highest resolution.

**04** The contrast ratio tells you the difference between the darkest and the brightest shades the screen can display. The higher the number, the darker the blacks and the brighter the whites. A screen with a high contrast ratio is more likely to show a wider range of detail. Plasma TVs generally have much higher contrast ratios than even the best LCD TVs.

**05** There are several ways to receive HD content. Sky HD has the widest selection of channels but requires a Sky HD box and monthly subscription. Freesat and Freeview HD bring you HD channels from the BBC, ITV and Channel 4. There are no monthly subscriptions – all you need is a compatible receiver. A Blu-ray player lets you watch HD movies on optical discs.

**06** Extra features, such as a network port, can be worth having because they may let you access online content, as well as media from a DLNA or UPnP server on your network.

## HOME CINEMA

### COMPUTER SHOPPER LG 47LB730V

BEST BUY ★★★★★

£649 inc VAT • [www.currys.co.uk](http://www.currys.co.uk)

The LG 47LB730V has one of the best screens and smart TV interfaces we've seen. With its fantastic design and great picture quality straight out of the box, the 47LB730V is great value.

SCREEN SIZE 47in • NATIVE RESOLUTION 1,920x1,080 • VIDEO INPUTS 3x HDMI, SCART, component, composite • TUNER Freeview HD • DIMENSIONS 1,061x666x227mm • WARRANTY Five years RTB • DETAILS [www.lg.com/uk](http://www.lg.com/uk) • PART CODE 47LB730V • FULL REVIEW Mar 2015



### COMPUTER SHOPPER SAMSUNG UE40H6400

BEST BUY ★★★★★

£419 inc VAT • [www.currys.co.uk](http://www.currys.co.uk)

This excellent mid-range TV has great picture quality, brilliant 3D performance and unparalleled online content. It's also available with screens from 32in up to 75in, so it's a perfect fit for any room.

SCREEN SIZE 40in • NATIVE RESOLUTION 1,920x1,080 • VIDEO INPUTS 4x HDMI, SCART, component, composite • TUNER Freeview HD • DIMENSIONS 598x918x267mm • WARRANTY One year RTB • PART CODE UE40H6400 • DETAILS [www.samsung.com/uk](http://www.samsung.com/uk) • FULL REVIEW Oct 2014



### COMPUTER SHOPPER OPTOMA HD151X

BEST BUY ★★★★★

£650 inc VAT • [www.scan.co.uk](http://www.scan.co.uk)

A great-value 3D projector that delivers fantastic image quality in all lighting conditions. Its large amount of lens shift makes it easy to set up and its optional wireless support gives it even more flexibility.

PROJECTOR TYPE DLP • NATIVE RESOLUTION 1,920x1,080 • VIDEO INPUTS HDMI, DVI-D, VGA x2, S-video, composite • LAMP LIFE 4,000h • LAMP BRIGHTNESS 2,800 Lumens • SIZE 162x386x280mm • WEIGHT 4.5kg • WARRANTY One year RTB • DETAILS [www.optoma.co.uk](http://www.optoma.co.uk) • PART CODE HD151X • FULL REVIEW Mar 2015



### COMPUTER SHOPPER LG NB3540

RECOMMENDED ★★★★★

£200 inc VAT • [www.currys.co.uk](http://www.currys.co.uk)

The NB3540 may not have many ports, but this simple 2.1 channel soundbar and wireless subwoofer is incredibly stylish and produces fantastic sound for the price.

SPEAKERS 2 • RMS POWER OUTPUT 160W • DIMENSIONS 770x75x35mm (soundbar), 196x297x390mm (subwoofer) • WEIGHT 1.3kg • DOCK CONNECTOR N/A • NETWORKING Bluetooth 3.0 • WARRANTY One year RTB • PART CODE NB3540 • DETAILS [www.lg.com/uk](http://www.lg.com/uk) • FULL REVIEW Dec 2014



### COMPUTER SHOPPER SAMSUNG BD-H6500

BEST BUY ★★★★★

£118 inc VAT • [www.ebuyer.com](http://www.ebuyer.com)

This 3D-capable Blu-ray player produces a great picture, offers an excellent range of Smart TV services and provides the best DVD upscaling we've seen at this price.

BLU-RAY PROFILE BD-Live (Profile 5) • HDMI VERSION 1.4 • 3D CAPABLE Yes • NETWORKING 1x 10/100, 802.11n • WARRANTY One year RTB • PART CODE BD-H6500 • DETAILS [www.samsung.com/uk](http://www.samsung.com/uk) • FULL REVIEW Oct 2014



## AUDIO

### COMPUTER SHOPPER SOUNDMAGIC E10

BEST BUY ★★★★★

£24 inc VAT • [www.hangsun.uk](http://www.hangsun.uk)

These earplug-style headphones sound loud, clear and balanced, with rich bass tones and plenty of natural character. They're a great buy if you add a £15 set of T-400 sound-isolating ear tips.

HEADPHONES TYPE In-ear • PLUG TYPE 3.5mm jack plug • WEIGHT 11g • CABLE LENGTH 1.2m • WARRANTY One year RTB • PART CODE E10-BKRD • DETAILS [www.soundmagic.com.cn](http://www.soundmagic.com.cn) • FULL REVIEW Apr 2012



### COMPUTER SHOPPER BLUESOUND Pulse

RECOMMENDED ★★★★★

£600 inc VAT • [www.sevenoakssoundandvision.co.uk](http://www.sevenoakssoundandvision.co.uk)

The audiophile's choice for multiroom audio. The Bluesound Pulse has excellent sound quality, support for high-resolution audio and is compatible with plenty of music-streaming services.

SPEAKERS 5 • RMS POWER OUTPUT 80W • DOCK CONNECTOR None • WIRELESS 802.11n Wi-Fi, 10/100 Ethernet, optional Bluetooth (SBC) • DIMENSIONS 420x190x97mm • WEIGHT 6.1kg • WARRANTY One year RTB • DETAILS [www.bluesound.com](http://www.bluesound.com) • FULL REVIEW Mar 2015



### COMPUTER SHOPPER CAMBRIDGE AUDIO G2

BEST BUY ★★★★★

£100 inc VAT • [www.richersounds.com](http://www.richersounds.com)

The Cambridge Audio G2 has excellent sound quality for a portable Bluetooth speaker and very respectable battery life.

SPEAKERS 2 • RMS POWER OUTPUT Not disclosed • DOCK CONNECTOR None • WIRELESS Bluetooth (SBC) • DIMENSIONS 189x55x67mm • WEIGHT 650g • WARRANTY One year RTB • DETAILS [www.cambridgeaudio.com](http://www.cambridgeaudio.com) • PART CODE G2 Mini Portable Bluetooth Speaker • FULL REVIEW Mar 2015



### COMPUTER SHOPPER APPLE iPod Touch

BEST BUY ★★★★★

£200 inc VAT • [store.apple.com/uk](http://store.apple.com/uk)

The fifth iPod Touch is the best device of its kind. Its battery lasts for three days of continuous music playback or eight hours of video. Its display is great and its audio is as reliable as ever, though format support is limited.

CAPACITY (FORMATTED) 32GB • DISPLAY 4in colour LCD touchscreen • SUPPLIED HEADPHONES Earphones • SUPPORTED AUDIO FORMATS AAC, MP3, AIFF, WAV, Audible • WARRANTY One year RTB • PART CODE MD7238T/A • DETAILS [www.apple.com/uk](http://www.apple.com/uk) • FULL REVIEW Feb 2013



### COMPUTER SHOPPER ARCAM miniBlink

RECOMMENDED ★★★★★

£90 inc VAT • [www.petertyson.co.uk](http://www.petertyson.co.uk)

Stream music from your mobile phone or tablet to your hi-fi with the petite and attractive miniBlink. This high-quality Bluetooth receiver sounds good and is delightfully simple to use.

WARRANTY Two years RTB • PART CODE miniBlink • DETAILS [www.arcam.co.uk](http://www.arcam.co.uk) • FULL REVIEW Aug 2014



SMART TV

SMART TV

PROJECTOR

SOUNDBAR

BLU-RAY PLAYER

IN-EAR HEADPHONES

PORTABLE SPEAKER

PORTABLE SPEAKER

MEDIA PLAYER

AUDIO INTERFACE



# Choosing an ...

## Inkjet printer

**01** You should be able to buy a decent inkjet printer for less than £40. High-quality printing is possible on such a printer, but it will be slow. The actual print speed of an inkjet can be half the quoted (maximum) speed for text documents, and even slower when printing graphics. Budget inkjet printers such as these are designed only for light use and can be expensive to run.

**02** For £60 you can buy a much more capable printer that's either faster and better built or better at reproducing photos. If documents are your priority, you'll want a high minimum speed and low print costs. Look for inkjets that can handle all your office media, such as envelopes and labels.

**03** If photos are your priority, speed is less important. Choose a printer that reproduces subtle tones well. You can't determine this by looking at the specifications – only hands-on testing will do, so remember to check our reviews before you buy. Borderless printing (up to the edge of the paper) should also be possible. Pay particular attention to running costs: photos use three times as much ink as regular colour documents.

**04** Heavy-duty office inkjets can cost up to £1,000 and their build quality is improving. They use large individual ink tanks, which can cut running costs. Printers with automatic duplex (double-sided) printing or A3 capabilities are now much more affordable.

**05** Pricier photo printers let you print from memory cards plugged straight into the printer, so you don't need to use a PC. An LCD preview screen offers greater control for this method of printing. Many inkjet printers now have a PictBridge USB port, which you can use to print images directly from most digital cameras.

**06** If you're really serious about photography, consider buying an inkjet that can produce borderless prints up to A3 size. The best devices can print photos that look nearly as good as those from professional labs.

## STORAGE

EXTERNAL HARD DISK



### G-TECHNOLOGY G-RAID Studio 8TB

★★★★★

£599 inc VAT • [store.apple.com/uk](http://store.apple.com/uk)

External storage doesn't get faster than this. The two 4TB hard disks in a RAID 0 array are even quick enough to edit 4K video, but you'll need a Thunderbolt port to plug it into.

CAPACITY 8TB • PRICE PER GIGABYTE £0.07 • INTERFACE Thunderbolt • WARRANTY One year RTB • PART CODE 0603366 • DETAILS [www.g-technology.com](http://www.g-technology.com) • FULL REVIEW Mar 2015



HARD DISK



### WESTERN DIGITAL Red 6TB

★★★★★

£214 inc VAT • [www.ebuyer.com](http://www.ebuyer.com)

The Red 6TB combines excellent performance with a high capacity and special firmware, making a hard disk that's perfect for use in NAS enclosures.

CAPACITY 6TB • PRICE PER GIGABYTE £0.03 • INTERFACE SATA3 • WARRANTY Three years RTB • PART CODE WD60EFRX • DETAILS [www.wdc.com](http://www.wdc.com) • FULL REVIEW Nov 2014



NAS DEVICE



### SYNOLOGY DS214Play

★★★★★

£283 inc VAT • [www.ebuyer.com](http://www.ebuyer.com)

This two-bay NAS enclosure transcodes video and audio files on the fly, so you can play them on devices that otherwise wouldn't support them. We had no problem streaming video or audio to any of our devices.

CAPACITY N/A • 3½in HARD DISK BAYS (FREE) 2(2) • NETWORKING 1x 10/100/1,000 • DLNA MEDIA SERVER Yes • PRINT SERVER Yes • DIMENSIONS 165x108x233mm • WARRANTY Two years RTB • PART CODE DS214PLAY • DETAILS [www.synology.com](http://www.synology.com) • FULL REVIEW Mar 2014



NAS DEVICE



### ASUSTOR AS-202TE

★★★★★

£186 inc VAT • [www.scan.co.uk](http://www.scan.co.uk)

The AS-202TE is a two-bay NAS enclosure with lots of USB ports to help you back up to and from external devices. You can also download third-party apps for extra features, and it's pretty cheap, too.

CAPACITY N/A • 3½in HARD DISK BAYS (FREE) 2(2) • NETWORKING 1x 10/100/1,000 • DLNA MEDIA SERVER Yes (optional install) • PRINT SERVER Yes • DIMENSIONS 108x163.5x230mm • WARRANTY Two years RTB • PART CODE AS-202TE • DETAILS [www.asustor.com](http://www.asustor.com) • FULL REVIEW Oct 2014



USB HARD DISK



### WESTERN DIGITAL My Passport Ultra 1TB

★★★★★

£50 inc VAT • [www.pcworld.co.uk](http://www.pcworld.co.uk)

This compact 5,400rpm USB3 external hard disk comes with excellent backup and encryption software. We reviewed the 1TB model, which is a bargain, but for an extra £25 you can pick up the 2TB version.

CAPACITY 2TB • SPINDLE SPEED 5,400rpm • INTERFACES USB3 • DIMENSIONS 15x82x11mm • WARRANTY Three years RTB • PART CODE WDBZFP0010BBK • DETAILS [www.wdc.com](http://www.wdc.com) • FULL REVIEW Sep 2013



## PRINTERS AND SCANNERS

MONO LASER PRINTER



### XEROX Phaser 3610

★★★★★

£322 inc VAT • [www.printerland.co.uk](http://www.printerland.co.uk)

The Phaser 3610 is a mono laser printer for small firms and workgroups. It's fast, reaching 47ppm in our tests, and has a claimed monthly duty cycle of up to 110,000 pages. Best of all, at 1.1p per page it's cheap to run.

TECHNOLOGY Mono laser • MAXIMUM PRINT RESOLUTION 1,200x1,200dpi • DIMENSIONS 315x395x426mm • WEIGHT 13kg • MAXIMUM PAPER SIZE A4/legal • WARRANTY One year onsite • PART CODE 3610V\_DN • DETAILS [www.xerox.co.uk](http://www.xerox.co.uk) • FULL REVIEW Jan 2014



PORTABLE PRINTER



### EPSON WorkForce WF-100W

★★★★★

£189 inc VAT • [www.morecomputers.com](http://www.morecomputers.com)

This flexible portable printer can be taken just about anywhere – just don't expect high speeds or low print costs.

TECHNOLOGY Piezo inkjet • MAXIMUM PRINT RESOLUTION 5,760x1,440dpi • DIMENSIONS (HXWXD) 61x309x154mm • WEIGHT 1.6kg • MAXIMUM PAPER SIZE A4/legal • WARRANTY One year RTB • DETAILS [www.epson.co.uk](http://www.epson.co.uk) • FULL REVIEW Mar 2015



OFFICE INKJET MFP



### CANON i-SENSYS LBP7780Cx

★★★★★

£449 inc VAT • [www.ebuyer.com](http://www.ebuyer.com)

It's somewhat expensive to buy, but the Canon i-SENSYS LBP7780Cx is very cheap to run and produces impressively high quality prints.

TECHNOLOGY Single-pass colour laser • MAXIMUM PRINT RESOLUTION 600x600dpi • DIMENSIONS (HXWXD) 401x517x530mm • WEIGHT 31kg • MAXIMUM PAPER SIZE A4/legal • WARRANTY One year onsite • DETAILS [www.canon.co.uk](http://www.canon.co.uk) • PART CODE 61408010AA • FULL REVIEW Mar 2015



OFFICE LASER PRINTER



### HP Officejet Pro X476dw

★★★★★

£391 inc VAT • [www.ebuyer.com](http://www.ebuyer.com)

It might be an inkjet, but HP's MFP beats many colour lasers in terms of speed, print quality and running costs.

TECHNOLOGY Thermal inkjet • MAXIMUM PRINT RESOLUTION 2,400x1,200dpi • SCANNER RESOLUTION 1,200x1,200dpi • DIMENSIONS (HXWXD) 517x517x399mm • WEIGHT 24kg • MAXIMUM PAPER SIZE A4/legal • WARRANTY One year onsite • DETAILS [www.hp.co.uk](http://www.hp.co.uk) • PART CODE CN461A • FULL REVIEW Mar 2015



INKJET MFP



### CANON Pixma MG5650

★★★★★

£74 inc VAT • [www.printerland.co.uk](http://www.printerland.co.uk)

This multifunction peripheral provides duplex printing and Wi-Fi, as well as good-quality scans, prints and copies, and at 7.3p per page its running costs are fairly low. It's an excellent general-purpose MFP.

TECHNOLOGY Thermal inkjet • MAXIMUM PRINT RESOLUTION 4,800x1,200dpi • SCANNER RESOLUTION 1,200x2,400dpi • DIMENSIONS 148x455x369mm • WEIGHT 6.3kg • MAXIMUM PAPER SIZE A4/legal • WARRANTY One year RTB • PART CODE 9487B008AA • DETAILS [www.canon.co.uk](http://www.canon.co.uk) • FULL REVIEW Dec 2014



For more storage, see the Group Test on page 94

## NETWORKS

PORTABLE 3G ROUTER



### TP-LINK M5350

★★★★★

£40 inc VAT • [www.currys.co.uk](http://www.currys.co.uk)

The M5350 is a bargain portable 3G router that's easy to set up and use. Its screen could be bigger, but the icons are clearly displayed. It's great for making the most of your data SIM.

MODEM 3G • WI-FI STANDARD 802.11n • USB PORTS None • WALL MOUNTABLE? No • WARRANTY Three years RTB • PART CODE M5350 • DETAILS [uk.tp-link.com](http://uk.tp-link.com) • FULL REVIEW Dec 2014



MODEM ROUTER



### ASUS DSL-AC68U

★★★★★

£180 inc VAT • [www.pcworld.co.uk](http://www.pcworld.co.uk)

The DSL-AC68U combines high-speed performance with the ability to use a 3G or 4G modem, operate as a NAS and share a USB printer.

MODEM ADSL2+/VDSL2 • WI-FI STANDARD 802.11ac • STATED SPEED 1,300Mbit/s • USB PORTS 1x USB3 • WARRANTY Three years RTB • PART CODE DSL-AC68U • DETAILS [www.asus.com](http://www.asus.com) • FULL REVIEW Jan 2015



WI-FI RANGE EXTENDER



### NETGEAR AC750-Wi-Fi Range Extender

★★★★★

£63 inc VAT • [www.dabs.com](http://www.dabs.com)

This Wi-Fi extender helps liven up the Wi-Fi deadzones in your home or office. It works on both the 2.4GHz and 5GHz bands simultaneously, and it even has an Ethernet port that's ideal for connecting devices such as games consoles and smart TVs.

WARRANTY Two years RTB • DETAILS [www.netgear.co.uk](http://www.netgear.co.uk) • PART CODE EX6100-100UKS • FULL REVIEW Nov 2014



POWERLINE KIT



### DEVOLO dLAN 1200+ Starter Kit

★★★★★

£160 inc VAT • [www.dabs.com](http://www.dabs.com)

Devol's dLAN 1200+ is the fastest Powerline networking kit we've seen, even if you're limited to a single Gigabit Ethernet connection. The passthrough sockets are very convenient too.

POWERLINE NETWORKING STANDARD HomePlug • STATED SPEED 1,200Mbit/s • ADAPTORS IN BOX 2 • WARRANTY Three years RTB • PART CODE 09378 • DETAILS [www.devolo.com/uk](http://www.devolo.com/uk) • PART CODE 09378 • FULL REVIEW Feb 2015



WIRELESS ROUTER



### LINKSYS WRT1900AC

★★★★★

£200 inc VAT • [www.dabs.com](http://www.dabs.com)

The WRT1900AC's Wi-Fi performance is superb whether you're using 802.11ac or 802.11n equipment, and its many features make it a must-buy for those who like to tinker.

MODEM None • WI-FI STANDARD 802.11ac • STATED SPEED 1,300Mbit/s • USB PORTS 2 • WALL MOUNTABLE Yes • WARRANTY Two years RTB • PART CODE WRT1900AC • DETAILS [www.linksys.com](http://www.linksys.com) • FULL REVIEW Aug 2014



## VIDEO

GAMEPLAY RECORDER



### HAUPPAUGE HD PVR Rocket

★★★★★

£115 inc VAT • [www.ebuyer.com](http://www.ebuyer.com)

The HD PVR Rocket lets you record your gameplay from a PC or games console, including your own commentary. It's well designed, with a large red Record button and the ability to record directly to a USB drive.

WARRANTY Two years RTB • PART CODE 1527 • DETAILS [www.hauppage.co.uk](http://www.hauppage.co.uk) • FULL REVIEW Apr 2013



CAMCORDER



### PANASONIC HC-X920

★★★★★

£690 inc VAT • [www.purewell.co.uk](http://www.purewell.co.uk)

This camcorder uses three 1/2.3in BSI MOS sensors to record Full HD video with excellent colour reproduction and tremendous detail. Its built-in Wi-Fi adaptor lets you connect to a smartphone or stream video over your network.

OPTICAL ZOOM 12x • SENSOR 3x1/2.3in BSI MOS • LCD SCREEN 3"/in LCD, 1,152,000 dots • DIMENSIONS 72x67x50mm • WEIGHT 471g • WARRANTY One year RTB • PART CODE HC-X920EB-K • DETAILS [www.panasonic.co.uk](http://www.panasonic.co.uk) • FULL REVIEW May 2013



CAMCORDER



### CANON Legria HF G30

★★★★★

£949 inc VAT • [www.johnlewis.com](http://www.johnlewis.com)

This fantastic enthusiast camcorder has a capacitive touchscreen monitor, a great electronic viewfinder and a sensible array of function buttons. Its image quality is excellent, too.

OPTICAL ZOOM 20x • SENSOR 1/2.3in CMOS • LCD SCREEN 3"/in LCD, 1,230,000 dots • DIMENSIONS 84x189x82mm • WEIGHT 900g • WARRANTY One year RTB • PART CODE 8454B009AA • DETAILS [www.canon.co.uk](http://www.canon.co.uk) • FULL REVIEW Sep 2013



SMART TV ADAPTOR



### AMAZON Fire TV

★★★★★

£79 inc VAT • [www.amazon.co.uk](http://www.amazon.co.uk)

Fire TV provides access to Amazon's Instant Video service, as well as on-demand services such as BBC iPlayer. You also get access to apps and games from Amazon's App Store, which can take advantage of the optional Amazon Fire TV game controller, making the Fire TV a simple games console.

VIDEO OUTPUTS HDMI • NETWORKING 802.11n (dual band) • DIMENSIONS 78x28x12mm • STREAMING FORMATS UPnP, AirPlay, DLNA • INTERNET STREAMING SERVICES iPlayer, Netflix, Sky News, Spotify, TuneIn Radio, Amazon Instant Video, TVPlayer • WARRANTY One year RTB • PART CODE Fire TV • DETAILS [www.amazon.co.uk](http://www.amazon.co.uk) • FULL REVIEW Dec 2014



ACTION CAMERA



### PANASONIC HX-A500E

★★★★★

£300 inc VAT • [www.fotosense.co.uk](http://www.fotosense.co.uk)

This Ultra HD wearable action camera produces excellent video and is comfortable to wear. You can connect it to a smartphone or tablet over Wi-Fi and stream live video to the web, too.

OPTICAL ZOOM None • SENSOR 1/2.3in BSI MOS • LCD SCREEN 1"/in, 115,200 dots • DIMENSIONS Camera: 27x69mm; operating unit: 59.5x94x26.7mm • WEIGHT Camera: 31g; operating unit: 128g • WARRANTY One year RTB • PART CODE HX-A500E • DETAILS [www.panasonic.co.uk](http://www.panasonic.co.uk) • FULL REVIEW Oct 2014



## Choosing an ...

## Action camera

**01** Action cameras are typically much smaller than a regular camcorder, as they are designed to be mounted to a bike, board or car, or worn on your person. As the name suggests, they are designed primarily for shooting action footage, but because of their small size they are ideal for strapping on to your pet's collar or your children's toys for a different perspective.

**02** Almost all action cameras will shoot Full HD video, and some will even shoot 4K, but frame rate is arguably more important than resolution when it comes to action video. Higher frame rates will mean smoother clips, and super-high frame rate videos can be played in slow motion to emphasise exciting shots. Keep an eye out for 4k/30p, 1080p/60 and 720p/120 models for the widest possible choice of resolutions and frame rates.

**03** Most action cameras rely on flash memory for storing your video, letting you swap out memory cards on the fly when you fill one up with clips. More expensive devices can have integrated flash memory as well as a card slot, but it's typically cheaper to buy the basic version of a camera and pick up memory cards separately.

**04** Not all action cameras have LCD displays; in fact, many deliberately don't include a screen in order to extend battery life. If you want to see exactly what you're pointing the lens at, keep an eye out for cameras with smartphone companion apps, or wrist-mounted viewfinders that also let you start and stop shooting remotely.

**05** Action cameras typically have a huge range of accessories, with specific mounts and harnesses for different activities and sports. If the camera itself isn't water resistant, a weatherproof case will protect it from the elements, while a tripod mount will let you lock it firmly in place. Spare batteries are essential for longer shoots, and some decent video-editing software will help you to produce a more polished result.



# Choosing an ...

## Intel motherboard

**01** It's essential that you buy the right type of motherboard for your processor. Intel's older 'Ivy Bridge' processors require a motherboard with an LGA1155 socket, but newer, fourth-generation 'Haswell' chips require an LGA1150 socket. A board for an Ivy Bridge processor must also have an H77 or a Z77 chipset, while Haswell processors require the new Z87 chipset.

**02** All current Intel processors have built-in graphics chipsets, so if you want to use your chip's built-in graphics, make sure the motherboard has the video outputs you need, such as VGA, DVI, HDMI and DisplayPort. If you want to play modern games, you'll need to fit a dedicated graphics card in the motherboard's PCI Express x16 slot, although this may block one of your other slots.

**03** Normal tower cases can accommodate ATX motherboards, which provide the most expansion slots. A microATX motherboard will let you build your PC in a smaller case, but if you opt for a microATX board, make sure it has all the features you need built in as there won't be much room for expansion cards.

**04** If you want to install lots of expansion cards, look for a motherboard that offers plenty of PCI and PCI-E x1 slots. Some motherboards also have PCI Express x4 slots and extra PCI Express x16 slots. PCI Express x1 and x4 cards also work in PCI Express x16 slots.

If you need a lot of storage, a motherboard with plenty of SATA2 and SATA3 ports is essential. SATA2 is fine for optical drives and hard disks, but to make the most of an SSD you need SATA3.

**05** All motherboards have built-in audio chipsets, but some support only 5.1 surround sound rather than 7.1. If you're connecting to older surround-sound amplifiers that don't have HDMI, look for an optical or coaxial S/PDIF output. All motherboards have Ethernet ports and most have the faster Gigabit version. You may also find it useful to buy a board with built-in Wi-Fi so you don't have to use up a USB port or PCI slot with an adaptor.

### COMPONENTS

GRAPHICS CARD	<b>COMPUTER SHOPPER</b> <b>RECOMMENDED</b>	<b>MSI GTX 970 Gaming 4G</b> <b>★★★★★</b> <b>£300 inc VAT • www.overclockers.co.uk</b> Graphics performance from the GTX 970 Gaming 4G approaches that of the more expensive GTX 980, making this the mid-range graphics card to buy. <b>GPU</b> Nvidia GeForce GTX 970 • <b>MEMORY</b> 4GB GDDR5 • <b>GRAPHICS CARD LENGTH</b> 269mm • <b>WARRANTY</b> Three years RTB • <b>PART CODE</b> GTX 970 Gaming 4G • <b>DETAILS</b> www.msi.com • <b>FULL REVIEW</b> Jan 2015	
	<b>COMPUTER SHOPPER</b> <b>RECOMMENDED</b>	<b>INTEL Core i7-4790K</b> <b>★★★★★</b> <b>£269 inc VAT • www.scan.co.uk</b> The Core i7-4790K is a beefed-up version of the Core i7-4770K, adding a substantial amount of power at stock speeds despite costing just a few pounds more. You can overclock it easily, too. <b>SOCKET</b> LGA1150 • <b>CORES</b> 4 • <b>FREQUENCY</b> 4GHz • <b>INTEGRATED GRAPHICS</b> Intel HD Graphics 4600 • <b>WARRANTY</b> One year RTB • <b>PART CODE</b> BX80646I74790K • <b>DETAILS</b> www.intel.com • <b>FULL REVIEW</b> Sep 2014	
PROCESSOR	<b>COMPUTER SHOPPER</b> <b>BEST BUY</b>	<b>AMD A10-6790K</b> <b>★★★★★</b> <b>£90 inc VAT • www.ebuyer.com</b> AMD's A10-6790K processor is cheaper than the A10-6800K but can be overclocked to match the 6800K's clock speeds. Its integrated graphics are good enough for high-quality gaming too, making it a bargain. <b>SOCKET</b> FM2 • <b>CORES</b> 4 • <b>FREQUENCY</b> 4GHz • <b>INTEGRATED GRAPHICS</b> Radeon HD 8670D • <b>WARRANTY</b> One year RTB • <b>PART CODE</b> A10-6790K • <b>DETAILS</b> www.amd.com • <b>FULL REVIEW</b> Mar 2014	
PROCESSOR	<b>COMPUTER SHOPPER</b> <b>BEST BUY</b>	<b>ASUS Z97-A</b> <b>★★★★★</b> <b>£112 inc VAT • www.dabs.com</b> The Asus Z97-A provides fast M.2 and SATA Express storage options, as well as great overclocking features. <b>SOCKET</b> LGA1150 • <b>DIMENSIONS</b> 305x224 • <b>CHIPSET</b> Intel Z97 • <b>MEMORY SLOTS</b> 4 • <b>PCI-E X16 SLOTS</b> 3 • <b>PCI-E X1 SLOTS</b> 2 • <b>PCI SLOTS</b> 1 • <b>USB PORTS</b> 4 • <b>VIDEO OUTPUTS</b> HDMI, DVI-D, DisplayPort, VGA • <b>WARRANTY</b> One year RTB • <b>PART CODE</b> Z97-A • <b>DETAILS</b> www.asus.com • <b>FULL REVIEW</b> Aug 2014	
INTEL MOTHERBOARD	<b>COMPUTER SHOPPER</b> <b>RECOMMENDED</b>	<b>CORSAIR Graphite 780T</b> <b>★★★★★</b> <b>£140 inc VAT • www.eclipscomputers.com</b> Corsair's huge Graphite 780T will take just about any PC components you choose, keeping them cool with plenty of fans and water-cooling options. It looks stunning too, and comes in a choice of colours. <b>CASE TYPE</b> ATX • <b>MOTHERBOARD COMPATIBILITY</b> E-ATX, XL-ATX, ATX, Micro-ATX, Mini-ITX • <b>SUPPLIED FANS</b> 3x140mm • <b>MAX 3 1/2 in DRIVE BAYS</b> 6 • <b>MAX 5 1/4 in DRIVE BAYS</b> 2 • <b>SIZE</b> 288x637x602mm • <b>WEIGHT</b> 11.3kg • <b>WARRANTY</b> Two years RTB • <b>PART CODE</b> CC-9011059-WW • <b>DETAILS</b> www.corsair.com/en • <b>FULL REVIEW</b> Feb 2015	
DESKTOP PC CASE			

### SOFTWARE

VIDEO EDITING	<b>COMPUTER SHOPPER</b> <b>BEST BUY</b>	<b>ADOBE Premiere Elements 13</b> <b>★★★★★</b> <b>£60 inc VAT • www.johnlewis.com</b> Premiere Elements 13 offers a wealth of features to keep advanced video editors happy and has even more to help new users make the most of it. It's the best consumer video-editing package you can buy. <b>OS SUPPORT</b> Windows 7/8 • <b>MINIMUM CPU</b> 2GHz with SSE2 • <b>MINIMUM GPU</b> DirectX 9 or 10 • <b>MINIMUM RAM</b> 2GB • <b>HARD DISK SPACE</b> 5GB • <b>DETAILS</b> www.adobe.com/uk • <b>PRODUCT CODE</b> 65234288 • <b>FULL REVIEW</b> Jan 2015
	<b>COMPUTER SHOPPER</b> <b>BEST BUY</b>	<b>SERIF PagePlus X8</b> <b>★★★★★</b> <b>£90 inc VAT • www.serif.com</b> This desktop-publishing application gives you full control over the layout and appearance of all your documents, from flyers and leaflets to professional-looking publications. This version adds a baseline grid, making text much easier to line up, and improves its photo-editing abilities. <b>OS SUPPORT</b> Windows XP or later • <b>MINIMUM CPU</b> Intel Pentium 4 or later, AMD Athlon 64 or later • <b>MINIMUM GPU</b> Not stated • <b>MINIMUM RAM</b> 512MB (Windows XP), 1GB (Vista, 32-bit Windows 7/8), 2GB (64-bit Windows 7/8) • <b>HARD DISK SPACE</b> 510MB • <b>DETAILS</b> www.serif.com/pageplus • <b>PRODUCT CODE</b> N/A • <b>FULL REVIEW</b> Feb 2015
DESKTOP PUBLISHING	<b>COMPUTER SHOPPER</b> <b>BEST BUY</b>	<b>SERIF Affinity Designer</b> <b>★★★★★</b> <b>£40 inc VAT • https://affinity.serif.com/en-gb</b> The first real competition to Adobe's Illustrator might be an OS X exclusive, but Affinity Designer is a seriously powerful graphic design tool that costs an incredible £40. <b>OS SUPPORT</b> Apple OS X 10.7.5 • <b>MINIMUM CPU</b> Core 2 Duo (64-bit) • <b>MINIMUM GPU</b> Intel HD Graphics • <b>MINIMUM RAM</b> 1GB • <b>HARD DISK SPACE</b> 325MB • <b>DETAILS</b> affinity.serif.com • <b>PRODUCT CODE</b> Affinity Designer • <b>FULL REVIEW</b> March 2015
OPERATING SYSTEM	<b>COMPUTER SHOPPER</b> <b>RECOMMENDED</b>	<b>ADOBE Photoshop Elements 13</b> <b>★★★★★</b> <b>£80 inc VAT • www.adobe.com/uk</b> Elements might not have all the features of the full version of Photoshop, but it's still our favourite photo-editing package, and version 13 is the best yet. A new Guided mode can help those new to editing achieve fantastic results. <b>OS SUPPORT</b> Windows 7/8 • <b>MINIMUM CPU</b> 1.6GHz with SSE2 • <b>MINIMUM GPU</b> DirectX 9 or 10 • <b>MINIMUM RAM</b> 2GB • <b>HARD DISK SPACE</b> 5GB • <b>DETAILS</b> www.adobe.com/uk • <b>PRODUCT CODE</b> 65237742 • <b>FULL REVIEW</b> Feb 2015
PHOTO EDITING	<b>COMPUTER SHOPPER</b> <b>BEST BUY</b>	<b>XARA Web Designer 10 Premium</b> <b>★★★★★</b> <b>£90 inc VAT • www.xara.com /uk</b> This latest version offers plenty of support for creating websites that work well on multiple devices, including phones and tablets. It's perhaps too simple for advanced web designers but is perfect for everyone else. <b>OS SUPPORT</b> Windows XP or later • <b>MINIMUM CPU</b> Intel Celeron/AMD Sempron • <b>MINIMUM GPU</b> Built-in graphics processor • <b>MINIMUM RAM</b> 500MB RAM • <b>HARD DISK SPACE</b> 500MB • <b>PRODUCT CODE</b> N/A • <b>DETAILS</b> www.xara.com • <b>FULL REVIEW</b> Oct 2014
WEB DESIGN		

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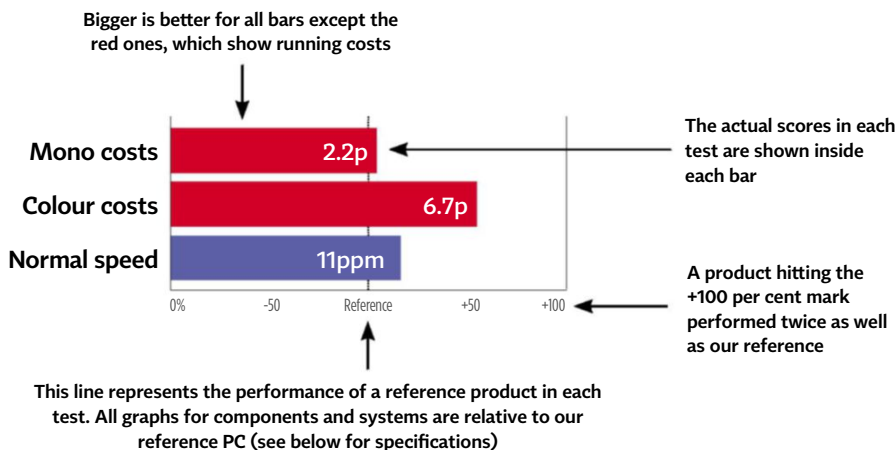
# How we test

Find out how well products perform with the help of *Computer Shopper's* comprehensive tests

## COMPUTER SHOPPER'S REVIEWS

use some of the most exhaustive testing procedures you'll find in any PC magazine. Every product is subjected to qualitative and quantitative tests that show how it performs in practical use. Graphs for performance, battery-life scores and costs are used in the *Reviews* section, as shown on the right. Look in the 'Summary of tests' box (below) for details of each test we run.

For PCs and laptops, we evaluate performance using our own custom benchmarking suite. See below for a brief description of our benchmarking software and game tests.



## SUMMARY OF TESTS

### PC SYSTEMS

Windows overall	Average speed across numerous demanding tasks
Multitasking	Speed when running simultaneous applications
Dirt Showdown (1080p)	Frames per second at 1,920x1,080, 4xAA, Ultra detail
Crysis 3	Frames per second at 1,920x1,080, High detail

### LAPTOPS

Windows overall	Average speed across numerous demanding tasks
Multitasking	Processor-intensive multitasking test
Dirt Showdown (720p)	Frames per second at 1,280x720, 4xAA, High detail
Battery life	Run time in minutes for continuous video playback

### HANDHELD/PORTABLE MEDIA PLAYERS/TABLETS

Battery life	Run time in minutes for continuous video playback
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### PRINTERS AND MFPS

Normal speed	Pages per minute for correspondence-quality text
Mixed colour speed	Pages per minute for presentable text and graphics
Photo speed	6x4in photos per minute at top quality setting
Mono costs	Running costs expressed as pence per page
Colour costs	Running costs expressed as pence per page

### DIGITAL CAMERAS

Battery life	Number of shots from full charge
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### CAMCORDERS

Battery life	Run time in minutes for recording
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### MP3 PLAYERS

Battery life	Run time in minutes for continuous playback
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### ROUTERS

Laptop 24GHz 10m	Mbit/s at 10m with laptop on 24GHz band
Laptop 24GHz 25m	Mbit/s at 25m with laptop on 24GHz band
Laptop 5GHz 10m	Mbit/s at 10m with laptop on 5GHz band
Laptop 5GHz 25m	Mbit/s at 25m with laptop on 5GHz band
Wi-Fi Adaptor 10m	Mbit/s at 10m with a Wi-Fi adaptor
Wi-Fi Adaptor 25m	Mbit/s at 25m with a Wi-Fi adaptor

### NETWORK-ATTACHED STORAGE

Large files	Average MB/s for read/write of 100MB large files
Small files	Average MB/s for read/write of 100MB small files

### HARD DISKS

Extra large files	Average MB/s for read/write of a 6GB file
Large files	Average MB/s for read/write of 100MB large files
Small files	Average MB/s for read/write of 100MB small files

### PROCESSORS

Windows overall	Average speed across numerous demanding tasks
Multitasking	Speed when running simultaneous applications
Dirt Showdown (720p)	Frames per second at 1,280x720, 4xAA, High detail

### MOTHERBOARDS

Windows overall	Average speed across numerous demanding tasks
Multitasking	Speed when running simultaneous applications
Dirt Showdown (1080p)	Frames per second at 1,920x1,080, 4xAA, Ultra detail
Dirt Showdown (720p)	Frames per second at 1,280x720, 4xAA, High detail

### GRAPHICS CARDS

3DMark	Performance settings, 1,920x1,080, 4xAA, 16xAF
Dirt Showdown (1080p)	Frames per second at 1,920x1,080, 4xAA, Ultra detail
Crysis 3	Frames per second at 1,920x1,080, High detail

## BENCHMARKS

### SHOPPER BENCHMARKS

Our benchmark suite uses open-source software that runs on Windows, Mac OS X and Linux systems. This lets us use objective results to compare PCs and laptops, no matter which operating system they run. It's designed to test each computer to its limit, using a combination of intensive image-editing, video-encoding and multitasking tests.

We ran the tests on our reference PC, which has an Intel Core i5-3570K processor, 4GB of DDR3 RAM and an AMD Radeon R7 260X graphics card. We normalised our results so this PC had a score of 100. This makes it easy to draw comparisons between test systems.

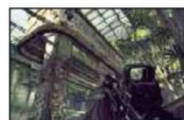
The resulting overall score is shown at the bottom of every PC and laptop review. As we use the same tests in our standalone and group test reviews, you can compare the performance of any computer, whether it's a netbook, laptop or desktop, from both sections of the magazine.

To see how your computer compares, you can download the suite from [www.shopperdownload.co.uk/benchmarks](http://www.shopperdownload.co.uk/benchmarks). Versions are available for 32-bit and 64-bit operating systems.

### 3D BENCHMARKS

#### CRYSIS 3

With full DirectX 11 support and high-resolution textures, Crysis 3 will push any PC to the limit. You'll need at least 30fps for smooth gameplay.



#### DIRT SHOWDOWN

Dirt Showdown is a cracking racing game that makes good use of DirectX 11's fancy graphical effects. You'll need at least 30fps for smooth racing.



#### 3DMARK

Futuremark's most recent synthetic 3D benchmark tests the latest DirectX 11 graphics features. It's representative of current and future titles.



## RATINGS & AWARDS

Computer Shopper rates products out of five:

Avoid	☆☆☆☆☆
Below average	★★★★☆
Good	★★★★☆
Very good	★★★★☆
Excellent	★★★★★

The best products can win the following awards:

### BEST BUY

Products with outstanding quality and performance for the money win our Best Buy award.



### RECOMMENDED

Products that don't quite qualify for a Best Buy award but are still highly rated by our reviewers.



### BUSINESS

The very best products for work win our Business Buy award.



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OR SEE PAGE 128**



# Free software guide

Your free gifts are now even easier to enjoy. Just download all the software from [www.shopperdownload.co.uk/326](http://www.shopperdownload.co.uk/326) and register with your unique coupon code



## Leawo iTransfer

**LEAWO ITRANSFER IS** a powerful tool designed to handle all your Apple file transfer needs.

The program can transfer files on iPhone, iPad and iPod devices to and from a PC or iTunes, but that's just the start. It can also transfer your data from device to device, such as iPhone to iPhone/iPod/iPad, iPod to iPod/iPhone/iPad, or iPad to iPad/iPod/iPhone.

Despite its many powers, Leawo iTransfer still needs iTunes to do some of its work, and so that must be installed first on your target PC. The program helps you out by warning if there's a problem, even providing a 'Download' button that opens a browser window at the relevant iTunes page.

Once you're ready, run iTransfer, connect your devices via USB and they'll be recognised by the program. You can back up each device **entirely**, or



transfer individual files just by dragging and dropping. If that sounds too hard then you can have iTransfer sync some of all files between your devices, PC and iTunes.

Whatever you're doing, smart filters and a file search tool make it easy to locate the files you need. You can also just use your iOS device as a USB disk, which is a convenient way to store important files and carry them around with you.

### GETTING STARTED

The download instructions on the opposite page show you how to connect to the download site. Please make sure that you type in the web address exactly as shown. You'll need your coupon code the first time you log on.

### ANY PROBLEMS

If you need help with any of the software this month, please send an email to [letters@computersshopper.co.uk](mailto:letters@computersshopper.co.uk). We check this inbox regularly. Please include the issue number of the magazine and your coupon code.

### WHY DOWNLOADS

Software manufacturers have been requiring us to use online registration for some time now, but increasingly we're being asked to provide the program as a download. In order to continue bringing you the best free software, we've revamped our download site. You need to use the unique code printed in the box on the facing page to register and download the software in this issue.

The unique code means we stop the deals leaking online, so only *Shopper* readers get the software. You'll also enjoy a smoother registration, where we handle the registration process.

### NO CODE?

If you don't have the card insert with the unique code, you must buy the £4.99 print version of the magazine. If you have bought this, please contact [letters@computersshopper.co.uk](mailto:letters@computersshopper.co.uk) for help and a new code.

**REQUIREMENTS** Windows XP, Vista, 7 or 8 32/64-bit, 30MB hard disk space  
**WEBSITE** [www.leawo.com](http://www.leawo.com)  
**NOTES** Get your registration code at [www.leawo.org/cooperation/shopper.html](http://www.leawo.org/cooperation/shopper.html)



## Ashampoo Burning Studio 2015

**ASHAMPOO BURNING STUDIO 2015** is a capable disc-burning suite with some unexpected and interesting features. Burning standard data discs is a very simple process: click Burn Data, New Disc from the menu, drag and drop your files on to the interface, and you can be burning your CD, DVD or Blu-ray disc in a couple of clicks.

The program can also create Autostart discs, which display interactive menus that appear when the disc is inserted. These can launch files or documents, send an email, link to a web page and more, and are a great way to present information.

The program's video functions are a little more basic. It's able to burn Video CDs (VCD) and Super Video CDs (SVCD) from source MPEGs, but it can only create video DVDs or Blu-rays from folders.

There's better news for music, as the program provides tools to create or rip audio CDs, build MP3 or WMA discs, and even design labels and covers. A simple backup tool enables you to select a few folders, then back them up to CD, DVD or Blu-ray, automatically splitting the archive across as many discs as required.

You also get more advanced options to create or browse disc images (ASHDISC, CUE/BIN, ISO, IMG), customise the file system of a disc, make discs bootable, and a whole lot more.

**REQUIREMENTS** Windows XP, Vista, 7 or 8 32/64-bit 200MB hard disk space  
**WEBSITE** [www.ashampoo.com](http://www.ashampoo.com)  
**NOTES** Get your registration code within the application



## Chat and Communication

**Digsby (Build 92)** Access all your instant messaging services from one application; there's support for Windows Live!, Yahoo!, AIM, Google Talk, ICQ and Jabber.

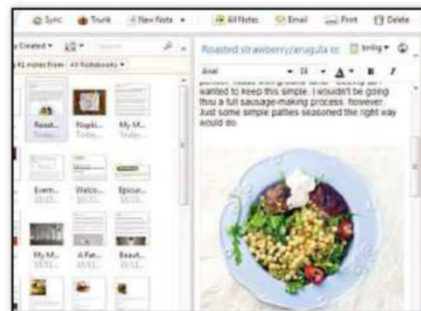
**UPDATED Evernote 5.8.1** Store your notes, ideas and plans in the cloud, and synchronise them between computers.

**Mozilla Thunderbird 31.3** A powerful email client from the organisation best known for the Firefox web browser.

**Postbox Express 1.0.1** An email client that provides a comprehensive array of tools to help you manage your messages more easily.

**Skype for Windows 7.0** Make internet voice and video calls for free, and buy credit to make calls to mobiles and landlines.

**UPDATED Trillian 5.5.0.19** Use all your instant messaging accounts with one application; this program has support for Windows Live!, AIM, Yahoo! and Google Talk.



## Customisation

**7 Taskbar Tweaker 4.5** Customise the Windows 7 taskbar so that it works exactly to your liking.

**Metro UI Tweaker for Windows 8**

Tweak the new user interface for Windows 8.

**Mosaic Desktop Beta 1 Refresh** Add Windows 8's mosaic-tiled desktop to your computer without having to upgrade.

**Rainmeter 3.0.2** Customise the desktop quickly and easily with your choice of information, tools and shortcuts.

**Windows 8 Transformation Pack 9.1**

Emulate the look of Windows 8 on an earlier version of the operating system.

**Windows 10 Transformation Pack 1** Bring some of Windows 10's new features to your current operating system.



## General

**UPDATED Free Studio 6.4.1** This software provides an easy way to convert your video and audio files into different formats.

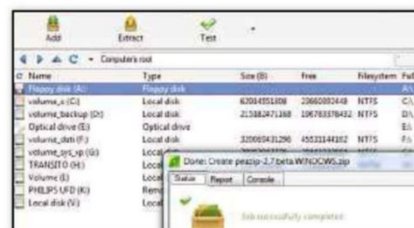
**Paragon Partition Manager 2014 Free** Create, format, split, merge and reorganise all your hard disk's partitions.

**UPDATED PeaZip 5.5.2** A tremendously powerful archive-management tool.

**Screenshot Captor 4.9.1** Create and manage screenshots the easy way.

**SUMo 3.11** Quickly scan your PC's installed applications and find any updates available for them.

**ZipGenius 6.3.2** A flexible file-compression tool with support for a huge number of compressed file formats.



## Internet and Network

**UPDATED CarotDAV 1.11.2**

Manage all your online storage services with one simple application.

**Cyberduck 4.6** A powerful but easy-to-use FTP client.

**Easy WiFi 4.01**

Find free Wi-Fi hotspots while you're out and about.

**UPDATED NetBalancer 8.5.1** Make the

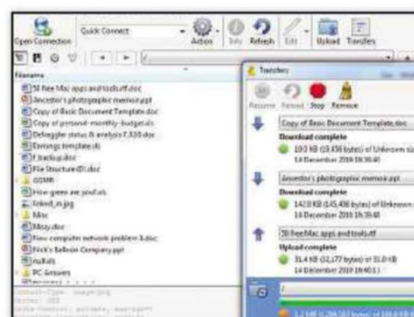
most of your internet connection by assigning download and upload priorities to web applications.

**TeamViewer 10.0**

Remote-control your computer from anywhere in the world.

**Vuze 5.4**

A BitTorrent client to help you locate, share and download torrent files.



## Tweaking and Performance

**UPDATED CCleaner 5.0.1** Remove unwanted information, temporary files, browsing history, huge log files and even the settings left behind by uninstalled software.

**Defraggler 2.18** Ensure that your system is defragmented properly and improve its performance with this useful defrag tool.

**Finestra Virtual Desktops 2.5** Set up four or more virtual desktops on your PC.

**IObit Advanced SystemCare 8**

A complete computer security, maintenance and optimisation suite.

**Revo Uninstaller Free 1.95** Remove installed applications completely, including all their folders, system files and Registry entries.

**Simple Performance Boost 1.0.5**

Tweak the Windows Registry to give your PC a performance boost.





## Crafting PCs the Scan way: Specification. Service. Satisfaction.



### Scan V1 Value System Home / Office PC

- Intel® Pentium® G3240 processor
- 4GB Corsair DDR3 1333MHz memory
- 500GB SATA 6Gb/sec hard drive
- Windows 8.1

**£299** Inc VAT

The V1 is a very capable entry-level system perfect from basic home/office tasks. It's based around the dual-core Intel® Pentium® G3240 processor, 4GB of RAM plus a 500GB hard disk.



### Scan V15 Value System Home / Office PC

- Intel® Core™ i5 4460 processor
- 8GB Corsair DDR3 1600MHz memory
- 1TB SATA 6Gb/sec hard drive
- Windows 8.1

**£489** Inc VAT

The V15 ups the ante by including a quad-core Intel® Core™ i5 4460 processor, so it makes light work of office and multimedia applications.



### Scan G20 Value System Gaming PC

- Intel® Pentium® G3240 processor
- 8GB Corsair DDR3 1600MHz memory
- 2GB NVIDIA GeForce GTX 750 Ti SSC
- 1TB SATA 6Gb/sec hard drive
- Windows 8.1

**£519** Inc VAT

Thanks to its dual-core Intel® Pentium® G3240 processor and NVIDIA GTX 750 Ti SSC graphics card the G20i is our most affordable gaming PC. It even includes surround sound!



### Scan G30i Value System Gaming PC

- Intel® Core™ i5 4460 processor
- 8GB Corsair DDR3 1600MHz memory
- 2GB NVIDIA GeForce GTX 760 SC ACX
- 1TB SATA 6Gb/sec hard drive
- Windows 8.1

**£685** Inc VAT

The combination of quad-core Intel® Core™ i5 4460 processor and NVIDIA GeForce GTX 760 graphics card ensures that the G30i can play any game you throw at it.



## Get the best of work and play with the new Windows.



### Scan Value PCs

A range of computers perfectly suited for the home/office. These affordable PCs are very flexible workhorses, capable of every task, from email/web surfing to high-end applications such as photo editing, video encoding and gaming. All of our Value Systems are pre-built and soak-tested so are ready to ship for next-day delivery.



Finance Available on  
PCs above £300



Built by award  
winning 3XS team



Fully soak tested



Fully 3XS  
compatible



Ready to ship



2 Year Warranty  
Part + Labour



**CUSTOMPC**  
AWARDS 2014  
Best  
PC Manufacturer

**CUSTOMPC**  
AWARDS 2014  
Editor's Choice  
Best Desktop PC

**CUSTOMPC**  
AWARDS 2014  
Highly Commended  
Retailer



## The most awarded PCs and Laptops Period.



### Scan 3XS Performance GT Gaming PC

- Intel® Pentium® G3258 overclocked to 4.4GHz
- 8GB Corsair DDR3 2133MHz memory
- 2GB NVIDIA GeForce GTX 760
- 1TB SATA 6Gb/sec hard drive
- Windows 8.1
- 3 Year Premium Warranty

**£639** inc VAT

The 3XS Performance GT is an affordably-priced gaming rig that includes a dual-core Intel Pentium G3258, which we overclock up to 4.4GHz for improved performance. Also included is a 2GB NVIDIA GeForce GTX 760 graphics card, 8GB of 2133MHz Corsair DDR3, a Z97 motherboard and 1TB hard disk.



### Scan 3XS Gamer 20i Gaming PC

- Intel® Core™ i7 4790 processor
- 8GB Corsair DDR3 2133MHz memory
- 4GB NVIDIA GeForce GTX 970 SC ACX
- 1TB Seagate HDD
- Windows 8.1
- 3 Year Premium Warranty

**£1075** inc VAT

The 3XS Gamer 20i is a super-fast gaming PC thanks to its combination of quad-core Intel Core i7 4790 CPU running at 3.6GHz with added Hyper-Threading plus a 4GB NVIDIA GeForce GTX 970 graphics card. These components are installed in an Asus Z97-K motherboard along with a 1TB hard disk.



### 3XS Graphite LG156 Gaming Laptop

- Intel® Core™ i5 4210M processor
- 8GB Corsair DDR3 1600MHz memory
- 2GB NVIDIA GeForce GTX 860M
- 15.6in 1,920 x 1,080 screen
- 1TB SATA 6Gb/sec hard drive
- Windows 8.1

**£855** inc VAT

The LG156 is 15.6" mid-range gaming laptop that includes a NVIDIA GeForce GTX 860M graphics card. The LG156 has won multiple awards in the press for its performance and value for money. The LG156 is ready for next-day delivery and has a 2 Year Warranty.



### 3XS Graphite LG1720 Gaming Laptop

- Intel® Core™ i7 4710HQ processor
- 8GB Corsair DDR3 1600MHz memory
- 3GB NVIDIA GeForce GTX 970M
- 17.3in 1,920 x 1,080 screen
- 1TB SATA 6Gb/sec hard drive
- Windows 8.1

**£1149** inc VAT

The LG1720 is a 17.3" high-end gaming laptop that includes a choice of powerful NVIDIA GeForce GTX 970M or 980M graphics card, ensuring silky smooth frame rates in all games. The LG1720 is ready for next-day delivery and has a 2 Year Warranty.



## Scan Computers recommends Windows.

### 3XS Custom Series

Our 3XS Custom Series is a range of computers designed to offer the best performance for a variety of applications, with a particular focus on games. We build Custom Series PCs to order, so we can configure and tailor make an individual PC just the way you want it. We can also overclock the processor, so you get a faster PC without a substantial increase in price. All 3XS Custom Series PCs are covered by a three year warranty as standard with the first year on-site.



Scan 3XS  
Overclocked



Built by award  
winning 3XS team



3 Year  
Warranty

**3XS SYSTEMS**





# POWER LAPTOPS

## Desktop replacements

Get all the power of a desktop PC in a portable package with one of these nine amazing laptops – without paying extra for the privilege

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**ASUS** N551JK

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**SCAN** 3XS Graphite LG156

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**TOSHIBA** Satellite S50-B-14P

**IF YOU WANT** to edit photos, produce videos or play games but don't like to be stuck at your desk, you need a laptop. It's true that in the past laptops were much more expensive than desktop PCs with similar performance, but these days it doesn't take an awful lot more cash to get what we'd consider to be fast desktop-replacement performance.

Powerful laptops had something of a resurgence in 2014, with big laptop manufacturers focusing on models that do more. That's why this month we're taking a look at machines from nine different manufacturers to see which firm has served up the best all-round laptop that will handle the toughest tasks without any fuss.

### IF LOOKS COULD THRILL

We're not purely looking at power. Anybody can stuff some high-end components into a chassis, stick on a keyboard and call it a laptop, but it won't be pleasing to the eye. Build quality, styling and noise levels are all taken into account here: when you're spending £600 or more on a laptop you shouldn't settle for something that you're going to hate looking at for years to come.

The laptops are desktop replacements, but we'll also award extra points to laptops that can be carried around thanks to their thin and light cases. Of course, some users may only

### PLAY TIME

Cheaper laptops typically forgo a dedicated graphics card, instead opting to use the processor's on-chip graphics. This is fine for simple tasks, but as soon as gaming and 3D work come into play, these integrated graphics chips become overwhelmed and performance slows to a crawl. Even cheap, low-power dedicated graphics chipsets can boost performance **hugely**, although they won't be able to handle the latest games.

Eight of the nine laptops on test have mid-range laptop graphics chips from Nvidia,



you'll probably need at least 16GB of RAM to ensure you have enough memory to handle several of these files at once. Buying more RAM can be **costly**, though, so if you don't want to **buy** the RAM up front you can always buy some more later on and install it **yourself**. See our guide in *Shopper 325* on how to do this.

Another area where you may find yourself short-changed is storage. Although most manufacturers include a high-capacity mechanical hard disk – normally 1TB – they will often only include high-performance SSDs in awkward sizes, such as 120GB. This means you'll have to decide carefully which applications and games you want to install.

If you have lots of programs or games and want to store them on faster solid-state storage, you'll likely need to upgrade to a 240GB disk. Some laptops don't come with an SSD at all, instead using hybrid hard disks that include a small amount of SSD storage. Which files are stored in this SSD cache is decided by the disk itself; the most frequently used files will be stored there. See our storage test on page 94 if you're looking to upgrade the storage in your current laptop or PC.

### SATISFACTION GUARANTEED

Finally, make sure you look at the warranty of your device, because they vary **wildly**. If you want peace of mind, opt for a laptop that comes with multiple years 'collect and return' cover, where the company covers the costs of shipping and repair of your laptop. Return to base (RTB) warranties are less generous: they make you pay for the shipping costs. Also check how long the parts cover on your laptop is; some companies cover labour but not the cost of replacing components.

## If you're buying a laptop from a system builder, don't be afraid to tweak the specifications to suit your own needs

want to move their laptop from room to room, but others may want to take them to work, on holiday or to a friend's house, so portability is a welcome extra feature.

Most of the laptops we're reviewing in this test have 15.6in screens. These laptops are large, but they should fit into most medium-sized backpacks. Two of them are 17.3in and you'll struggle to put these into anything but the biggest of bags. In some cases a larger chassis allows for higher-specification components, but in the case of the laptops we've reviewed, these machines have the same components as their smaller rivals and perform nearly **identically**. The only advantage to having such a large screen in this situation is that onscreen items will appear larger and that you'll get a slightly roomier keyboard.

In this test, we have much higher minimum standards for screens than we normally do. All the laptops here have Full HD 1,920x1,080 pixel screens. You should expect nothing less from laptops costing £600 and more.

### DUE PROCESS

All but two of the laptops we've reviewed this month have quad-core, Intel Core i7 processors on board. These chips aren't the most powerful laptop processors Intel produces, but they offer the best compromise between price and performance without requiring complex and expensive cooling systems. They typically have performance levels similar to high-end Core i5 chips found in desktop PCs costing around £600.

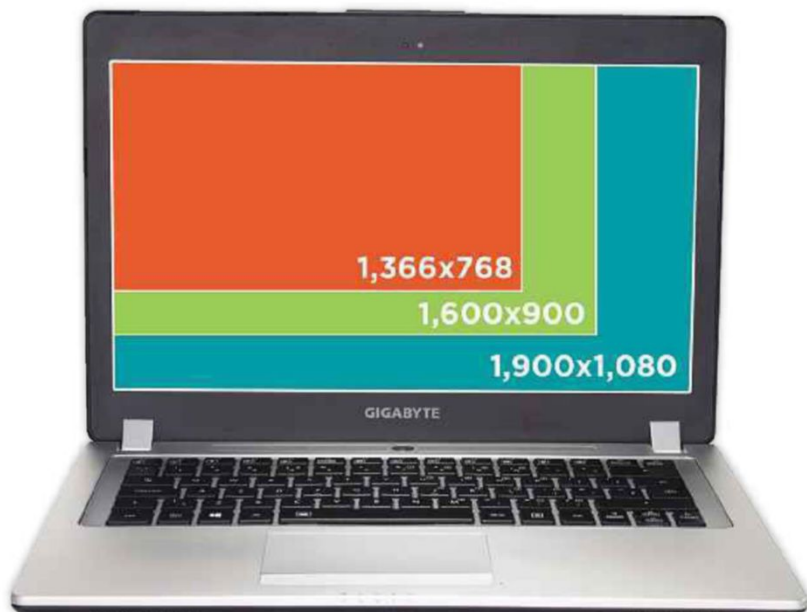
When buying a powerful laptop, you should check how many cores its processor has. **Generally**, when it comes to processors with similar clock speeds, the more cores the better. The more cores you have, the better performance you'll get in complex tasks such as photo and video editing, and you'll see a small boost in games, too. Intel's i7 processor also has Hyper-Threading, which creates two threads for each processor core, meaning applications can more efficiently use the cores available to them, increasing performance **further**.

which are easily capable of playing the latest games. Actual performance varies from game to game, so you'll need to make careful graphics adjustments to each game you play to make sure you get the best performance possible. Our guide on page 90-91 to getting the best gaming performance from your laptop will help get you started.

### PICK AND MIX

If you're buying a laptop from a system builder, don't be afraid to tweak the specifications to suit your own needs. To keep the price **low**, most companies have put what we consider to be the minimum amount of RAM in their machines. Most laptop makers will provide units with 8GB of RAM. While this is enough for most uses, if you're going to be working with large photo or 4K video files

## Resolution comparison



↑ Manufacturers of cheaper laptops call 1,366x768 pixel screens 'HD', but such screens don't give you enough space to work or play; we'd always opt for Full HD 1,920x1,080



**ACER**

## Aspire V Nitro VN7-591G

£850 inc VAT • From [www.saveonlaptops.co.uk](http://www.saveonlaptops.co.uk)**VERDICT**

Great looks and build, high performance and a low price: Acer's latest foray into gaming laptops is a resounding success

**ACER IS KNOWN** for its down-to-earth laptops, but the 15.6in Aspire V Nitro is an attempt to capture people with deep pockets rather than budget-minded family PC buyers. This laptop has been out of stock before, but Acer assures us that more will be available from mid-March if you can't buy it now.

Acer has set the Nitro apart from its other, more reserved laptops with a stylish, textured black lid and gunmetal hinge accent below the screen with an embossed logo, which can be seen when the screen is open and closed. The soft-touch black palm rest completes the look, making it one of the nicest laptops we've seen.

It's thin, at 2.4cm at its thickest point, and pretty light, too, at 2.4kg. This doesn't include the rather weighty power brick, which you will need to have on you at all times. You pay for the laptop's svelte build with poor battery life, which we measured at just 2h 48m in our general use test, although this is par for the course for similarly specified laptops.

The keyboard has red LED backlighting, but this is a subtle effect in anything other than night-time conditions. The keys themselves don't have a huge amount of travel, but we found the small distance to be sufficient for long periods of typing and gaming. We had no problems with missed keystrokes, either.

Sadly, the touchpad isn't quite as good as the keyboard. It's an all-in-one model, placing the physical mouse buttons at the bottom of the touchpad itself, with the pad clickable about a quarter of the way down. In itself this isn't a problem, but we did find ourselves frustrated by the coating on the pad, which is slightly too grippy and left some movements, such as two-fingered-scrolling, feeling juddery and unpleasant for our fingers.



There are four speakers in the chassis, and we were astounded by their quality. They are loud, have perceptible stereo separation and even some bass presence, which is tremendously impressive. This, combined with how quietly the laptop runs even under load, sets the Nitro apart from almost every other high-performance laptop we've tested.

You get three USB3 ports, HDMI, a Fast Ethernet connector and a 3.5mm headset jack on the right side of the laptop. Inside, there's dual-antenna MIMO (multiple-input multiple-output) Wi-Fi for enhanced throughput with compatible routers with multiple antennas.

Inside is a quad-core 2.5GHz Intel Core i7-4710HQ processor, a proven powerhouse, backed up by 8GB of RAM and a 1TB hard disk with 8GB of SSD cache. In our multimedia tests the Nitro managed an impressive score of 91, doing particularly well in image-rendering (96) and multitasking (97), although it found the video conversion test tougher, where it scored 81. In real terms, this laptop is lightning fast when browsing the web and editing documents, and is also capable of editing videos and dealing with

high-resolution photos.

Processing performance is matched by gaming prowess, thanks to the mid-range Nvidia GeForce GTX 860M graphics chip, which has impressed us in the past. In our Full HD Dirt Showdown tests with 4x anti-aliasing and Ultra graphics settings, the Nitro produced an average frame rate of 41.1fps, which is very playable. In the tougher Crysis 3 test on High settings, this dropped to an average of 26.5fps. We wouldn't call this

enjoyable, but it takes only a few tweaks, such as switching to medium settings and lowering anti-aliasing, to bring this up to a stable 35fps. At this price, you can't expect much more, and most modern games will be able to run on Medium or High settings.

We were also pleased with the 15.6in Full HD (1,920x1,080) screen, which sits a rung or two above the panels you'll find on cheaper laptops. We measured the sRGB colour gamut coverage at 84.7 per cent, which is good for a laptop and about what we'd expect at this price. This is backed up by a decent contrast ratio of 1,019:1 and a reasonably low black level of 0.31cd/m². It's not a visual feast, but anyone going from a cheaper laptop to the Nitro will definitely see an improvement.

We're really impressed with Acer's first proper foray into the gaming laptop market. The Aspire V Nitro is handsome, well built and is a competent performer in every task you're likely to throw at it. It's not quite as good value as the £800 17.3in PC Specialist Optimus V Exige, but if you want a smaller laptop you can realistically put into a bag and take out into the world, the Acer Aspire V Nitro is a brilliant choice.

**SPECIFICATIONS**

**PROCESSOR** Quad-core 2.5GHz Intel Core i7-4710HQ  
**RAM** 8GB  
**SIZE** 389x257x23.9mm  
**WEIGHT** 2.4kg  
**SCREEN SIZE** 15.6in  
**SCREEN RESOLUTION** 1,920x1,080  
**GRAPHICS ADAPTOR** 2GB Nvidia GeForce GTX 860M  
**TOTAL STORAGE** 1TB SSHD (8GB SSD cache)  
**OPERATING SYSTEM** Windows 8.1  
**WARRANTY** One year RTB  
**DETAILS** [www.acer.co.uk](http://www.acer.co.uk)  
**PART NUMBER** NX.MQLEK.002



## ASUS N551JK

COMPUTER  
SHOPPER  
BEST BUY£599 inc VAT • From [www.amazon.co.uk](http://www.amazon.co.uk)

## VERDICT

With a powerful processor, dedicated graphics and a Full HD screen, the Asus N551JK is a brilliant-value desktop replacement laptop

**BULKY, MULTIMEDIA** desktop replacement laptops are usually incapable of carrying themselves with a sense of style, but the 15.6in Asus N551JK is a welcome exception.

The swooping curves on the left and right vents make this chunky 2.7kg machine look more elegant and thin than it is, which is hard to do with a laptop that's over 3cm thick. Among the design flourishes is a selection of ports that include Mini DisplayPort, HDMI, Gigabit Ethernet, two 3.5mm ports, three USB3 ports and a DVD drive. Inside, 802.11n Wi-Fi and Bluetooth are also present.

This excellent design continues to the keyboard, which has some of the chunkiest laptop keys we've used. The chiclet-style keys have a huge amount of travel to them and are pleasingly quiet, making them very satisfying to use. The touchpad isn't quite as strong, with the built-in mouse buttons feeling a little cheap and harsh to press. The touchpad also has slightly too much friction to it, but once we were familiar with its feel, we had few issues navigating Windows, dragging items and using multifingered gestures.

With such a bulky design, you'd expect the N551JK to have a high-capacity battery. With such powerful components inside, though, the six-cell battery was used up after just 4h 10m in our light-usage test. However, it's probably not the sort of laptop you're going to be spending a great deal of time using on the move, so this shouldn't be too big a problem.

Overt audio branding rarely adds up to impressive audio performance, and the Bang & Olufsen-stickered internal speakers in the N551JK are average at best. They're loud, but that's about all they have going for them: there's no bass presence and no stereo separation, making for an underwhelming overall experience. Asus also provides a



subwoofer in the box with the laptop, which plugs into the tiny 2.5mm audio jack on the left side of the device. It's a small woofer, but it makes a huge difference to the depth of the sound. You'll only be able to use it when stationed at a desk, however, as there's nowhere to place the sub on the laptop itself.

The 2.8GHz Intel Core i5-4200H processor is paired with 8GB of RAM. In our multimedia tests the laptop managed an overall score of 68, performing particularly well in the single-core focused photo-conversion test, in which it managed 82. In real terms, you'll be able to perform multimedia tasks at a decent speed, although rendering times will be longer than on a similarly priced desktop PC.

You also get the added bonus of a capable graphics card: the Nvidia GeForce GTX 850M is a mid-tier chip capable of handling some more recent games at medium settings at the laptop's native Full HD resolution. In our standard Dirt Showdown test at 1,280x720 resolution and High graphics settings, the N551JK produced an average frame rate of 78.7fps. Increasing the resolution to the laptop's native 1,920x1,080 pixels yielded 41.7fps, which is still more than playable.

Very challenging games with advanced graphics effects will be more of a challenge for this chip, though. Our representative test is the ageing but still graphically advanced Crysis 3. A quick run through the game's Swamp level on High settings resulted in a very jerky 19fps. However, dropping the graphics to more reasonable 1x anti-aliasing and Low texture settings saw the frame rate rise to 37.9 fps, which is playable, if not pretty. You'll have plenty of room to

store all your games and other files thanks to the 1TB hard disk. There's no SSD or SSD cache for speedier storage performance, but at this price we wouldn't expect it.

The N551JK's screen has a quality Full HD 1,920x1,080 panel, giving you plenty of room to put windows side-by-side and have more room to breathe when browsing the web and editing photos. Colour performance is impressive, with the screen capable of displaying 94 per cent of the sRGB colour gamut, according to our measurements. This is a major step up compared to many similarly priced laptops, with vibrant colours displaying accurately on screen. Contrast levels of 754:1 and black levels of 0.48cd/m<sup>2</sup> lead to a nicely balanced image with plenty of detail visible even in more subtly shaded images. Make sure you turn off Adaptive Brightness in Windows, as it is extremely irritating on the N551JK, constantly flickering between light and darker settings.

The Asus N551JK is a supremely impressive laptop at an almost unbelievably low price, with a good processor, dedicated graphics and a superb screen. At this price, it's the best desktop-replacement laptop you can buy.

## SPECIFICATIONS

**PROCESSOR** Dual-core 2.8GHz Intel Core i5-4200H  
**RAM** 8GB  
**SIZE** 383x255x31.5mm  
**WEIGHT** 2.7kg  
**SCREEN SIZE** 15.6in  
**SCREEN RESOLUTION** 1,920x1,080  
**GRAPHICS ADAPTOR** 2GB Nvidia GeForce GTX 850M  
**TOTAL STORAGE** 1TB hard disk  
**OPERATING SYSTEM** Windows 8.1  
**WARRANTY** One year collect and return  
**DETAILS** [www.asus.com/uk](http://www.asus.com/uk)  
**PART NUMBER** N551JK-CN073H





# CHILLBLAST Jupiter



£750 inc VAT • From [www.chillblast.com](http://www.chillblast.com)

## VERDICT

A good entry-level gaming laptop, but you can get much better graphics performance for £50 more

**CHILLBLAST'S 15.6in JUPITER** desktop-replacement laptop uses one of the plainest chassis we've come across, with just a single company logo on the lid breaking up the monotony. While it's not the most attractive laptop, the chassis doesn't feel too badly made and there's very little cheap-feeling flex to it, but we still can't wait for the day where the suppliers of these chassis put a little more thought into their creations.

At 3cm thick, there's plenty of room for connectors around the Jupiter's edges. A DVD drive, two 3.5mm audio jacks, a USB and a USB3 port sit on the right while the left has HDMI and VGA outputs, a Gigabit Ethernet connector and two more USB3 ports, one of which doubles up as an eSATA connector.

The laptop runs almost silently when idling, but the fans kick in as soon as it has to do even moderately taxing tasks such as installing programs, but they're unobtrusive. Things get louder when playing graphically demanding games, but even then it's just a moderate whooshing noise that's easy to ignore. The keyboard tray and wrist rest are warm most of the time but don't feel uncomfortably hot even when playing games.

Battery life in our light use test, which involves playing videos and scrolling through web pages, was fairly short at 4h 17m, but not surprising for a powerful laptop you'll probably keep stationed at a desk most of the time.

The keyboard isn't backlit and its keys don't have a huge amount of travel, but they're fairly responsive and comfortable to type on. The touchpad is also responsive, with clicking, dragging and two-fingered scrolling all easily accessible. The physical mouse buttons aren't pleasant to use and feel rather harsh when pressed, but it's otherwise fine.

Desktop-replacement laptops typically prioritise processor performance above other



features, and Chillblast has plumped for the tried and tested 2.5GHz quad-core Intel Core i7-4710MQ processor. This chip can Turbo Boost to 3.5GHz when thermal conditions allow, giving it desktop levels of performance in previous benchmarking tests we've conducted. In the Jupiter and paired with 8GB of RAM, it managed an overall score of 97 in our benchmarking tests, peaking in the multitasking test where it scored 105. Anything above 100 beats our Intel Core i5 desktop benchmark machine, so these scores equate to lightning-quick performance in basic tasks and decent data-crunching ability in more complex tasks.

This is all helped along by the 120GB SSD, although this is only really big enough to store your most commonly accessed programs and files. A 500GB hybrid hard disk with 8GB of SSD cache is also included for the rest of your files.

The graphics card inside the Jupiter is the mid-range Nvidia GeForce GTX 850M. This puts it a rung below other £800-£900 laptops we've tested, which is a shame. The 850M is perfectly competent but it's ever so slightly hamstrung when compared to the 860M, a

stalwart of more gaming-focused laptops. Still, we

were able to get some decent gaming benchmark scores out of it: Dirt Showdown, which represents moderately challenging modern games, ran at Full HD resolution and Ultra detail at a smooth 41.7fps.

We had to be a bit more crafty with Crysis 3, though: determined to get the game to run at Full HD resolutions we turned the graphics settings to Low, with anti-aliasing at 1x. At these settings we were able to

improve the frame rate to a playable 37.9fps. At High settings, 19fps was as good as it got, so this was a marked improvement.

We weren't bowled over by the Jupiter's screen. While its 1,920x1,080 pixel resolution is very welcome, colour performance is disappointing. We measured the screen as able to produce just 69.7 per cent of the sRGB colour gamut, meaning more vibrant colours appear slightly washed out. It's a bright screen, at least, and we measured its peak brightness at 318cd/m². A small amount of backlight bleed is visible from the bottom of the panel, but otherwise the brightness is fairly even. Contrast levels are good at 917:1, which meant plenty of detail in more subtle shading was visible in our tests.

The Chillblast Jupiter is a decent 15.6in multimedia and gaming laptop, especially when you consider the presence of an SSD for speedier application performance. The extremely generous two-year collect-and-return warranty and five years of parts cover is also not to be sniffed at. However, the impressive PC Specialist Optimus V Exige is just £50 more and comes with a better graphics card and more storage.

## SPECIFICATIONS

**PROCESSOR** Quad-core 2.5GHz Intel Core i7-4710MQ  
**RAM** 8GB  
**SIZE** 374x252x31.4mm  
**WEIGHT** 2.5kg  
**SCREEN SIZE** 15.6in  
**SCREEN RESOLUTION** 1,920x1,080  
**GRAPHICS ADAPTOR** 2GB Nvidia GeForce GTX 850M  
**TOTAL STORAGE** 120GB SSD, 500GB SSHD (8GB SSD cache)  
**OPERATING SYSTEM** Windows 8.1  
**WARRANTY** Two years collect and return, five years parts and labour  
**DETAILS** [www.chillblast.com](http://www.chillblast.com)  
**PART NUMBER** Jupiter



# CYBERPOWER

## Fangbook Evo HX6-100



£800 inc VAT • From [www.cyberpowersystem.co.uk](http://www.cyberpowersystem.co.uk)

### VERDICT

A keenly priced and powerful gaming laptop, but the styling and build quality may put some buyers off

### CYBERPOWER'S FANGBOOK EVO HX6-100

is a performance laptop with distinctive design cues that make it stand out. It may be a bit much for some people; indeed, buyers looking for an understated laptop should look elsewhere, because the Fangbook Evo looks like a slightly unrefined Alienware laptop.

The lid of the MSI-designed chassis is covered in a honeycomb-effect black and silver sticker with silver lines surrounding a red Cyberpower logo in the middle. There's also a red plastic accent that runs around the edge of the laptop. The palm rest is made from a black brushed-metal and plastic composite that's cool to the touch. It looks good, but picks up dust and grease easily.

The chiclet-style keyboard is backlit by red LEDs that match the laptop's overall colour scheme, and there are also red highlights behind the speaker grille below the screen. It's a consistent look, but it's a shame about the ugly sticker on the lid.

The usual complement of connection ports can be found around the edge of the chassis. The right side has a VGA port, USB port and DVD drive, while the left side has three more USB ports (two of them USB3), a full-size HDMI output and two 3.5mm audio jacks.

There's plenty of room for files and games on the 1TB mechanical hard disk, although there's no separate SSD or any SSD cache on this particular disk. You can upgrade using Cyberpower's online system configuration tools, if you're prepared to pay extra.

The keyboard is excellent. The keys are chunky and they offer plenty of travel and feedback. Our only minor gripe is that the layout is slightly unusual, with the Windows key located on the right of the spacebar rather than the left and the return key being a



half-height button. There's also a gap between the keyboard tray and the rest of the chassis that looks rough and cheap. The touchpad, which is an all-in-one affair with no separate physical buttons, is mostly responsive, although it feels a little flimsy, with even light taps making it rattle. Multifingered gestures work well, though.

The Fangbook Evo HX6-100 isn't short on processing power, thanks to its quad-core, 2.5GHz Intel Core i7-4710MQ processor and 8GB of RAM. With these components desktop levels of performance are possible. It raced through our multimedia benchmarking tests and finished with an overall score of 93. Its best performance came in the multitasking test, which requires it to play and convert video files and render photographs simultaneously, scoring 101. A whoosh of fan noise was audible, but we didn't find it to be a distraction.

There's also an Nvidia GeForce GTX 860M graphics card with 2GB of video memory. This mid-range card is capable of some giant-killing performances, but we've often found some tweaking is required to get things running smoothly on the most graphically advanced games. Dirt Showdown at Full HD resolution and Ultra graphics ran at a smooth 49.9fps, while Crysis 3 at High settings was somewhat less smooth at 28.6fps.

Games and movies will look good on the laptop's Full HD 15.6 display. It's one of the best screens we've seen at this price, managing to display 91.3 per cent of the sRGB colour gamut with reasonable contrast levels of 629:1.

The built-in speakers aren't up to much and, if you're going to be stationed at a desk with this laptop, you should buy some desktop speakers for

when you're watching movies or playing music. Headphones would be a great idea if you're going to be playing games, too.

We were pleased with the 5h 20m we were able to extract from the Fangbook Evo HX6-100 during our battery test; if you were to take this laptop out and about you could definitely survive a few hours without a nearby charging point. If you're gaming, though, expect this figure to drop significantly.

The Cyberpower Fangbook Evo HX6-100 is a well-rounded desktop-replacement laptop with an interesting, albeit divisive, design. It has a powerful processor and a good dedicated graphics card and matches its 15.6in rivals in terms of specifications and price. Its screen is better than most, which is a notable selling point. It's not a well built as the thin and beautiful Acer Aspire V Nitro, although that laptop is £50 more expensive.

If you're looking to spend around £800 on a powerful laptop, the Cyberpower Fangbook Evo HX6-100 is a reasonable choice. Our only minor issue is that the collect-and-return warranty lasts for only a month. You should also consider the similarly priced PC Specialist Optimus V Exige.

### SPECIFICATIONS

PROCESSOR	Quad-core 2.5GHz Intel Core i7-4710MQ
RAM	8GB
SIZE	383x249x37.1mm
WEIGHT	2.6kg
SCREEN SIZE	15.6in
SCREEN RESOLUTION	1,920x1,080
GRAPHICS ADAPTOR	2GB Nvidia GeForce GTX 860M
TOTAL STORAGE	1TB hard disk
OPERATING SYSTEM	Windows 8.1
WARRANTY	One year RTB
DETAILS	<a href="http://www.cyberpowersystem.co.uk">www.cyberpowersystem.co.uk</a>
PART NUMBER	Fangbook Evo HX6-100





## DINOPC Pegasus 17.3"



£799 inc VAT • From [www.dinopc.com](http://www.dinopc.com)

### VERDICT

**Big and brash, but the DinoPC Pegasus is underspecified compared to its rivals**

**DINOPC'S PEGASUS IS** a gargantuan 17.3in desktop replacement with mid-range graphics and processing performance for buyers who are happy to be stationed at a desk. At 3.2kg and over 4cm thick, it's a laptop for those who like their tech with a bit of meat on the bone.

Like many independent manufacturers, DinoPC has used an off-the-shelf Clevo chassis for its laptop. This isn't the most attractive chassis available, and the rather bulky and square case makes the Pegasus a little ugly. Given that other manufacturers can make large and attractive laptops, it's a shame DinoPC couldn't find a more attractive chassis. Still, it's what's inside that really counts.

It's good to see a 120GB SSD alongside a traditional 1TB mechanical hard disk. The SSD is plenty big enough for Windows 8.1 and your favourite apps, giving the laptop a healthy speed boost; the 1TB hard disk gives you loads of room for all your files.

A dual-core 2.6GHz Intel Core i5-4210M processor and 8GB of RAM are at the heart of



Crysis 3 required a little tweaking to get playable performance, as is always the case with the mid-range 860M. In benchmarking conditions its average frame rate was playable 24.7fps, but when the bullets started flying it dropped to a jerky 13fps. Tweaking the settings to 1x anti-aliasing and Medium System Spec allowed us to keep the game

to respond at all. You'll want to plug in a USB mouse into one of the four USB ports (three of them USB3). As well as these connectors, there's an eSATA port, which doubles up as a USB3 port, an SD card reader, full-size HDMI and VGA outputs, Gigabit Ethernet, and three separate 3.5mm audio jacks.

The quality of the 17.3in Full HD screen is what we'd expect from an off-the-shelf laptop, with 82.1 per cent sRGB colour gamut coverage picked up by our colour calibrator. This means colours are relatively well represented, and the 1,312:1 contrast ratio means detail in darker spots in games and movies are relatively well served.

Battery life is nothing to shout about at 4h 55m, but we can't imagine this PC will spend much of its life out and about. If you do plan on disconnecting from the grid, bear in mind that processor- and graphics-intensive tasks will reduce battery life by more than half.

The DinoPC Pegasus is a capable laptop that can power its way through most tasks. Its main problem is the existence of the PC Specialist Optimus V Exige, which costs the same but has a bigger SSD and a more powerful processor, making it a better buy.

## Performance isn't bad, with an overall score of 61, but we've seen laptops at this price score 30 points more

the Pegasus laptop. Performance isn't bad, with an overall score of 61, but we've seen laptops at this price score 30 points more. That's not to say the Pegasus can't cope with what you throw at it, but we'd have expected a faster CPU at this price.

Gaming performance is much better thanks to the Nvidia GeForce GTX 860M graphics chip. This mid-range option is a powerful choice and one we often see in laptops at this price. It managed a frame rate of 50fps in our Dirt Showdown benchmark.

looking pretty while also boosting the frame rate to a much more playable 42.7fps.

Under load the Pegasus is not noisy, so you won't have to worry about the deafening roar heard from more compact gaming laptops. However, you'll need headphones, because the speakers are truly dreadful. While we'd expect most users to plug in headphones or speakers when using laptops this large, it's definitely possible for manufacturers to provide better audio quality for those times when there's nothing plugged in.

When it's open, the Pegasus is a little more attractive,

and the silver palm rest and pleasingly chunky keyboard are definite highlights. The keyboard is pleasing to type on; long periods of work and play don't become arduous and we had no problems with missed key presses, which can often be the downfall of cheaper laptop chassis.

The touchpad is woefully bad, though; it has too much friction and sometimes failed



### SPECIFICATIONS

**PROCESSOR** Dual-core 2.6GHz Intel Core i5-4210M

**RAM** 8GB

**SIZE** 413x278x44mm

**WEIGHT** 3.2kg

**SCREEN SIZE** 17.3in

**SCREEN RESOLUTION** 1,920x1,080

**GRAPHICS ADAPTOR** 2GB Nvidia GeForce GTX 860M

**TOTAL STORAGE** 120GB SSD, 1TB hard disk

**OPERATING SYSTEM** Windows 8.1

**WARRANTY** Three years RTB including one year parts

**DETAILS** [www.dinopc.com](http://www.dinopc.com)

**PART NUMBER** Pegasus 17.3"

# GIGABYTE P15F v2



£789 inc VAT • From [www.saveonlaptops.co.uk](http://www.saveonlaptops.co.uk)

## VERDICT

**A perfectly capable desktop replacement laptop, but it's not much cheaper than its significantly more powerful rivals**

**GIGABYTE'S P15F V2** is a reasonably portable 15.6in desktop replacement with a powerful Intel Core i7 processor and a mid-range graphics card for gaming and graphics work.

Gigabyte has used a standard Clevo chassis which it has customised and improved. Other laptops we've seen with this case have had rather cheap, plastic lids; Gigabyte has used a soft-touch matt black plastic that feels much more pleasant and also looks more stylish thanks to gently tapering edges. This material does show some greasy marks, but it's not as bad as some other laptop lids. The palm rest is made of a different matt black plastic that doesn't pick up grease quite so easily.

Sadly, Gigabyte hasn't done anything to address the quality of the keyboard. Its keys are spongy and have little travel to them, so they're not particularly pleasant to use and typing becomes tiresome after long periods.

With such a big chassis, there's plenty of room for ports: there's a DVD drive, two USB ports (one USB3) and two 3.5mm audio jacks



78.9 per cent, colours appear cold and a little washed out. This isn't helped by poor contrast levels of just 256:1 and very poor viewing angles, which make the overall viewing experience disappointing. Games and movies simply won't look that good on the P15F, which is what we'd expect most buyers of this laptop will be interested in.

## Modern games aren't out of the reach of this laptop, but you'll need to tweak them to make them playable

on the right, while the left side has a VGA port, HDMI connector, eSATA (doubling up as USB3) and a Gigabit Ethernet port.

A 1TB hybrid hard disk is included, which has an 8GB high-performance solid-state cache for faster boot times and loading times of your most frequently used apps. There's no SSD, though, which is a shame, as we've seen other laptops at this price with one.

We've also seen better choices of screen in this chassis. While our colour calibrator showed its overall accuracy is reasonable at

Processor performance is excellent, though. The quad-core 2.5GHz Intel Core i7-4710MQ is a proven success and enduringly popular with laptop manufacturers, providing near-desktop levels of performance in every laptop we've tested it in. This was no different with the P15F, which, with its 8GB of RAM, managed an overall score of 89 in our multimedia benchmarks. Multitasking was particularly strong; it scored 98 in this test, just two points off our reference Core i5 desktop machine. This laptop will race through simple

Windows tasks and browsing the web, and is no slouch when editing videos and photos, either.

Fan noise isn't too big an issue; while whooshing sounds were audible, they were far from intrusive. Nonetheless, if you want quality audio you should invest in a set of desktop speakers or headphones, because the ones built into the chassis are typically average for a laptop, lacking depth and volume.

Graphics performance comes from an Nvidia GeForce GTX 850M, which is a cheap mid-range chip that can hold its own in some modern games. In our Dirt Showdown test at Ultra settings and Full HD resolution it was able to output an average frame rate of 41.7fps. Dirt Showdown is a few years old but has plenty of visual effects that challenge modern graphics cards.

The trickier Crysis 3 proved to be a bigger challenge, with an average frame rate at High settings and 4x anti-aliasing yielding a jerky 19fps. Dropping anti-aliasing to 1x and lowering texture details to Low improved things to a more playable 37.5fps. If you have trouble running some new titles on the P15F, dropping the resolution to 1,600x900 will also help significantly. Modern games aren't out of the reach of this laptop, but you'll need to tweak them to make them playable.

The Gigabyte P15F v2 is a good-looking 15.6in laptop that's also very powerful, but it's currently too expensive compared to the competition. The PC Specialist Optimus V Exige costs only a little more, but has a more powerful graphics card and is a better choice.



## SPECIFICATIONS

**PROCESSOR** Quad-core 2.5GHz Intel Core i7-4710MQ  
**RAM** 8GB  
**SIZE** 374x252x31.4mm  
**WEIGHT** 2.5kg  
**SCREEN SIZE** 15.6in  
**SCREEN RESOLUTION** 1,920x1,080  
**GRAPHICS ADAPTOR** 2GB Nvidia GeForce GTX 850M  
**TOTAL STORAGE** 1TB SSHD (8GB SSD cache)  
**OPERATING SYSTEM** Windows 8.1  
**WARRANTY** Two years RTB  
**DETAILS** [www.gigabyte.com](http://www.gigabyte.com)  
**PART NUMBER** P15F v2



## PC SPECIALIST

### Optimus V Exige



£799 inc VAT • From [www.pcspecialist.co.uk](http://www.pcspecialist.co.uk)

#### VERDICT

An amazing-value desktop replacement with a big SSD and great performance, but it comes in an ugly chassis

**PC SPECIALIST'S OPTIMUS V Exige** is a 17.3in, 3.2kg laptop that on paper looks to be one of the best-value laptops we've ever reviewed, with a capable graphics card, powerful processor and a large SSD.

If you're going to benefit from this value, you'll first have to accept that it has one of the ugliest Clevo chassis on the market. PC Specialist hasn't helped by choosing not to add any sort of system badge or sticker to break up the monotony of the dark grey lid. Open up the machine and you're greeted with a large black keyboard in a sea of metallic grey, and a tiny grey touchpad just below it.

The keyboard is comfortable to use, but if you're a harsh typist it does sound like you're typing on a hollow plastic box, which doesn't exactly ooze *quality*. The touchpad isn't very good at all; it's not sensitive enough and its two physical buttons have very little travel.

The usual selection of ports are available around the back and sides of the laptop, with three USB3 ports (one of which also doubles as an eSATA connector), two USB ports, a

and palm rest remaining cool in normal use. Fire up a game and the rear-facing fans begin to whirr and get louder with more intense use, but they weren't overbearingly noisy during our testing. Still, the whooshing of the fans will likely overpower the atrocious speakers, which are barely capable of pushing out music at an audible volume, let alone dialogue and the more subtle noises in games and movies. Invest in a decent set of desktop speakers or headphones when you buy this laptop, otherwise you'll be left disappointed.

## PC Specialist has been very generous with the storage, including a 1TB hard disk and a 240GB SSD

Gigabit Ethernet port, an SD card reader, a VGA port and an HDMI connector.

PC Specialist has been very generous with the storage, including a 1TB hard disk and a 240GB SSD. This is more than we've ever seen from laptops at this price, and is even more generous than many more expensive laptops.

The Optimus V Exige runs quietly when not under significant load, with the keyboard

The screen isn't the best we've seen but it holds its own against similarly priced rivals. The 17.3in Full HD panel is able to cover 82.1 per cent of the sRGB colour gamut, according to our tests. This leaves very vibrant colours a little washed out, but the amount of detail in images is helped by a high contrast of 1,312:1.

Processing power is one area where the Optimus V Exige excels. The quad-core 2.5GHz Intel Core i7-4710MQ processor is paired with 8GB of RAM and races through simple and tough tasks alike, scoring a near-desktop score of 93 in our benchmarks.

Gaming and multimedia performance is also helped by the 2GB Nvidia GeForce GTX 860M graphics card. This card's presence in such an otherwise well-specified laptop is great to see. It's capable of playing modern games in Full HD at Medium or High settings, as



was demonstrated by the 46.8fps average frame rate it recorded in *Dirt Showdown* at Full HD resolutions at High settings. *Crysis 3* was *trickier*, with an average of 29.8fps at High settings with 4x anti-aliasing, but on occasion dropping to 15fps when the action got intense. We dropped the anti-aliasing to 1x, which made in-game objects much more jagged but increased the average frame rate to 40.1fps and brought the minimum frame rate up to a much more playable 26fps.

Performance in our light usage battery test was unremarkable at 5h 13m. If you take this behemoth out and about, expect the battery life to be less than half that when gaming. We'd keep this machine stationed at a desk.

We're impressed with the PC Specialist Optimus V Exige. For £800 you get a 17.3in laptop with a 240GB SSD and a GTX 860M graphics card, making it an absolute steal. Our main issue is with the bulky chassis, which at best is plain, and at worst just plain *ugly*. If that doesn't offend you and you don't need to carry your computer far, you should buy this laptop. Otherwise, take a look at the beautiful Acer Aspire V Nitro, which has superb build quality and equally good performance.

#### SPECIFICATIONS

**PROCESSOR** Quad-core 2.5GHz Intel Core i7-4710MQ

**RAM** 8GB

**SIZE** 413x278x44mm

**WEIGHT** 3.2kg

**SCREEN SIZE** 17.3in

**SCREEN RESOLUTION** 1,920x1,080

**GRAPHICS ADAPTOR** 2GB Nvidia GeForce GTX 860M

**TOTAL STORAGE** 240GB SSD, 1TB hard disk

**OPERATING SYSTEM** Windows 8.1

**WARRANTY** Three years RTB including one year parts

**DETAILS** [www.pcspecialist.co.uk](http://www.pcspecialist.co.uk)

**PART NUMBER** Optimus V Exige



# SCAN 3XS Graphite LG156

COMPUTER  
SHOPPER  
RECOMMENDED

★★★★★

£899 inc VAT • From [www.scan.co.uk](http://www.scan.co.uk)

## VERDICT

The popular 3XS Graphite LG156 returns with more storage and the same quality chassis, but its rivals have caught up

**SCAN'S 3XS GRAPHITE** LG156 has been one of our favourite desktop-replacement laptops for a couple of years, but with its competitors now producing slightly cheaper laptops with similar specifications, its crown is under threat. Even so, there's still a lot to like here.

It uses the popular quad-core 2.5GHz Core i7-4710MQ processor, which can Turbo Boost up to 3.5GHz when thermal conditions allow for it. With its 8GB of RAM, the LG156 tore through our multimedia tests with a score of 89. This means basic tasks such as web browsing and watching videos feel snappy and responsive, and more complex multimedia activities such as photo and video editing will also be substantially faster than they would on cheaper laptops.

The LG156 has a 2GB Nvidia GeForce GTX 860M graphics chip on board. In our more challenging Crysis 3 benchmark, with graphics quality set to High and resolution to 1,920x1,080, it achieved an excellent average frame rate of 29.4fps. During action-packed sequences, the frame rate dropped to just below 19fps, so we'd recommend reducing the texture quality to Medium and reducing anti-aliasing for more stable and smooth gameplay.

We're happy with both the design and build of this particular Clevo-designed chassis, which is a nice break from the norm. It's thick at 42mm and relatively heavy at 2.7kg, but the 3XS logos, backlit keyboard and chunky keys make the laptop look very inviting. The keys are responsive and have lots of travel to them, which makes long periods of use comfortable. The touchpad is also responsive and has a smooth texture to it, although you'll want to use a USB mouse if you want to be productive or play games competitively.

The 15.6in screen is bright and relatively vibrant, although vertical viewing angles are a



little narrow, but you shouldn't have too many issues manoeuvring the screen into a more visually comfortable position. Our quality measurements showed that it's a decent display overall, capable of displaying 73.8 per cent of the sRGB colour gamut and with a contrast ratio of 723:1.

The chassis is 43mm thick and weighs 2.7kg, putting this laptop at the more extreme end of what you'd be willing to carry around if you were to take it with you on a journey. It's not unbearable, though, as long as you have a decent backpack to put it in.

There are two USB3 ports, a combined USB3 and eSATA port and a USB port. You can attach external displays to the HDMI and VGA outputs, and you can attach headphones and a microphone to the separate 3.5mm audio jacks. You'll probably want to attach the LG156 to desktop speakers, too, as the built-in speakers sound hollow and tinny, and not worthy of the high-specification games you'll be playing on it.

Scan has upped the amount of storage on this iteration of the LG156, ditching the 1TB hybrid hard disk from last year's model and replacing it with Western Digital's Black<sup>2</sup>

120GB SSD and a 1TB dual drive while keeping the price the same.

We were impressed with the LG156's keyboard. The keys are springy and responsive, and provide excellent feedback when typing and gaming, although we did find the sharp edges of the palm rest to be a little uncomfortable during longer sessions. The touchpad, while not suited to gaming, is responsive enough for general navigation tasks.

There's also a fingerprint scanner between the two touchpad buttons for added security.

Fan noise is audible but acceptable for our tastes, although we were less than pleased with the slight hissing emanating from the speaker grille when the processor was under load. It's not a major annoyance most of the time, though, and will only be noticeable when you're not gaming or watching videos.

As is the case with most gaming laptops, the LG156's battery life is fairly unremarkable, lasting 3h 8m in our tests. However, this isn't a laptop you'll use when travelling: the Scan 3XS Graphite LG156 is designed to be a replacement for your desktop PC.

Scan's 3XS Graphite LG156 remains one of our favourite desktop-replacement laptops, although without changing the price it does run the risk of being overtaken by rivals with similar specifications that cost a lot less. However, the extra money has been well spent, we think: the chassis is one of the better-quality off-the-shelf housings we've seen, and the two-year RTB warranty is more generous than the single-year cover you get with many other manufacturers.

## SPECIFICATIONS

PROCESSOR	Quad-core 2.5GHz Intel Core i7 4710MQ
RAM	8GB
SIZE	374x250x42.7mm
WEIGHT	2.7kg
SCREEN SIZE	15.6in
SCREEN RESOLUTION	1,920x1,080
GRAPHICS ADAPTOR	2GB Nvidia GeForce GTX 860M
TOTAL STORAGE	120GB SSD, 1TB hard disk (Dual drive)
OPERATING SYSTEM	Windows 8.1
WARRANTY	Two years RTB
DETAILS	<a href="http://www.scan.co.uk/3xs">www.scan.co.uk/3xs</a>
PART NUMBER	3XS Graphite LG156





# TOSHIBA Satellite S50-B-14P



£615 inc VAT • From [www.johnlewis.com](http://www.johnlewis.com)

## VERDICT

A great-value portable laptop with a good screen and dedicated graphics, but it feels very fragile

**BUSINESS LAPTOPS ARE** Toshiba's bread and butter, so we had high expectations for the Satellite S50-B-14P. We reviewed the S50T-B-10H in *Shopper 320*, and liked its looks and performance but were disappointed with its non-Full HD touchscreen. For the S50-B-14P, Toshiba has swapped out the touch-sensitive panel, equipped the laptop with a Full HD screen and dropped the Intel Core i7 processor for an i5 chip. All this results in a laptop costing nearly £200 less but looking much more attractive on paper.

Unlike many desktop replacements, the S50-B-14P is thin and relatively light. There's no optical drive, but if you're not a heavy DVD or CD user this shouldn't be too much of an issue. At just 2.08kg it's one of the lighter desktop replacements we've tested, and at 2cm thick it's more than a third thinner than most of the machines on test. In other words, this desktop replacement is easily portable.

It's made from brushed aluminium-style plastic, which looks great but feels slightly cheap; the lid in particular is surprisingly flexible. The wrist rest and keyboard tray feel more solid, and the keys are satisfying to use despite a lack of travel and bounce. They're quiet, grippy and comfortable, and we found it easy to build up to quick typing speeds. The touchpad is responsive, too. We were concerned by a rather large and unsightly gap that appeared between the chassis and the touchpad, as well as a very loose panel between the two screen hinges. These, plus the flexible lid, make us wonder whether this laptop can survive the rigours of life being shoved into bags and dropped on to desks.

A Gigabit Ethernet port and a USB port are on the left edge of the chassis, while two USB3 connectors, a 3.5mm headset port and a

full-size HDMI output can be found on the right. There's also an SD card reader set into the curve under the front of the chassis. Inside, there's a 128GB SSD instead of the S50T-B-10H's 1TB mechanical hard disk. This may be a problem because once it's been partitioned and had Windows 8.1 installed on it, there's just under 60GB of space left. We'd have liked a mechanical hard disk for storage as well.

The Full HD screen is good for the money. We measured the screen as able to display 81.5 per cent of the sRGB colour gamut. High contrast levels of 1,034:1 and decent black levels of 0.31cd/m<sup>2</sup> make for reasonably vibrant and detailed images. The glossy screen won't be to everyone's taste, and we found it difficult to find a position where our bright office lights didn't cause problems with viewing images and text on the screen.

The dual-core 1.7GHz Intel Core i5-4210U is built for power and thermal efficiency, but it can still perform admirably when demand requires it, Turbo Boosting to a clock speed of 2.7GHz. It's capable of whizzing through Windows and web pages in a flash, and more complex multimedia tasks are helped along by the presence of an entry-level AMD

Radeon R7 M260 graphics chip with 2GB of memory. In our multimedia

benchmarking tests the laptop managed a perhaps slightly disappointing overall score of 49. Its performance peaked in the image-rendering test, in which it scored 70. Tasks needing faster multicore performance brought the average down, though, with scores of 46 and 43 for the video conversion and multitasking tests respectively. These aren't terrible scores by any means, but you will find yourself waiting around longer if you're going to

be performing more complex tasks on this laptop.

The AMD Radeon R7 M260 graphics card is included more as a performance boost for multimedia tasks than as a gaming tool. In the *Dirt Showdown* benchmark test at 1,280x720 pixel resolution and High detail, the S50-B-14P managed a just-playable frame rate of 30.8fps. At Full HD resolution and Ultra detail, 15fps was all it could muster. You'll definitely be able to play basic games such as *Minecraft* on this laptop, but more advanced games will be beyond its reach.

The battery lasted for 5h 17m in our battery benchmark test. For a powerful laptop, this is fine, but considering its weight and thinness it would have been nice to be able to take the laptop out for a full day without having to worry about battery life.

We're ambivalent about the Toshiba Satellite S50-B-14P. The Full HD screen is well worth the price of swapping out the Intel Core i7 processor for the i5, although some may be upset by the lack of high-capacity storage. Our main gripe with the S50-B-14P is its build quality, which we feel should be much better at this price. There's no excuse for gaps between panels and loose pieces of plastic, especially in a laptop that's inevitably going to be taken out and about. At this price, the Asus N551JK is a better choice, although it is heavier.

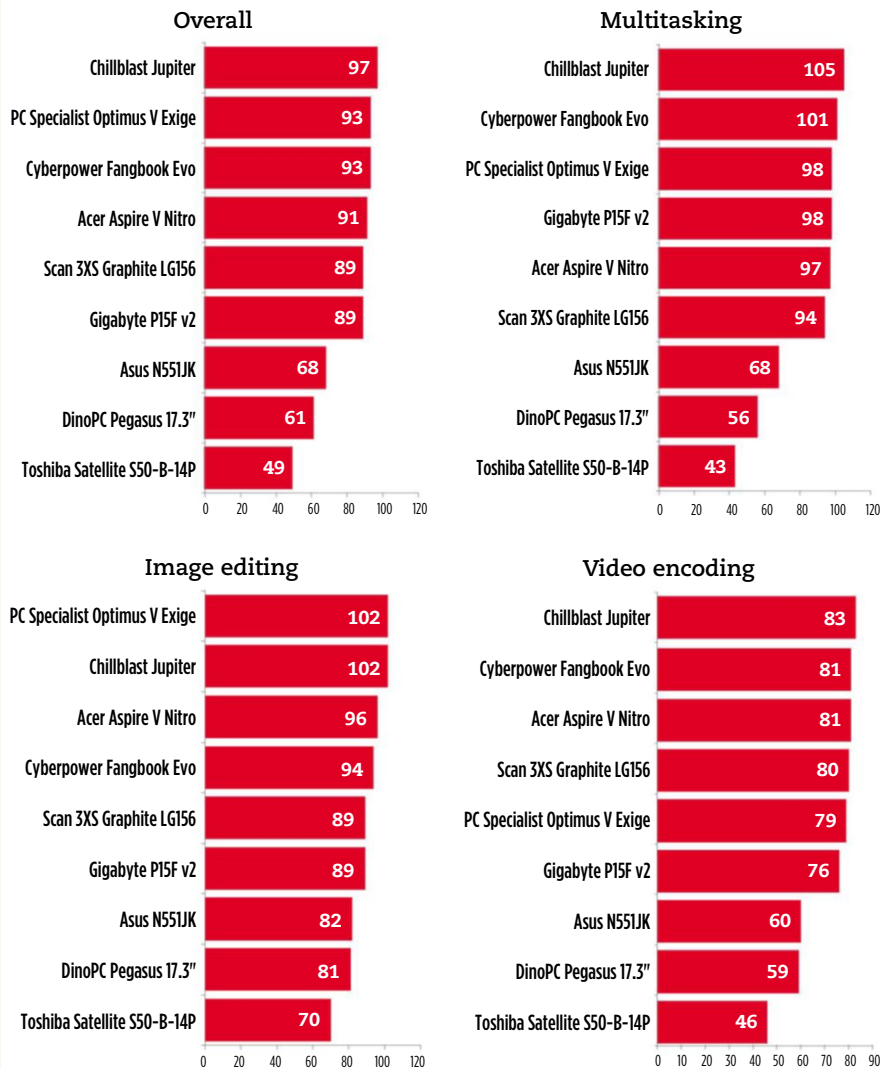
## SPECIFICATIONS

<b>PROCESSOR</b>	Dual-core 1.7GHz Intel Core i5 4210U
<b>RAM</b>	8GB
<b>SIZE</b>	380x262x20mm
<b>WEIGHT</b>	2.1kg
<b>SCREEN SIZE</b>	15.6in
<b>SCREEN RESOLUTION</b>	1,920x1,080
<b>GRAPHICS ADAPTOR</b>	2GB AMD Radeon R7 M260
<b>TOTAL STORAGE</b>	128GB SSD
<b>OPERATING SYSTEM</b>	Windows 8.1
<b>WARRANTY</b>	One year collect and return
<b>DETAILS</b>	<a href="http://www.toshiba.co.uk">www.toshiba.co.uk</a>
<b>PART NUMBER</b>	PSPQ6E-04200XEN



## BENCHMARKS

## 2D performance



Our benchmark suite allows us to compare Windows, Mac OS X and Linux PCs.

The tests use open-source applications to gauge a laptop's performance, and comprise image-editing, video-editing and multitasking elements. These scores are added to produce the overall score.

Our reference PC is fitted with an Intel Core i5-3570K processor and 4GB

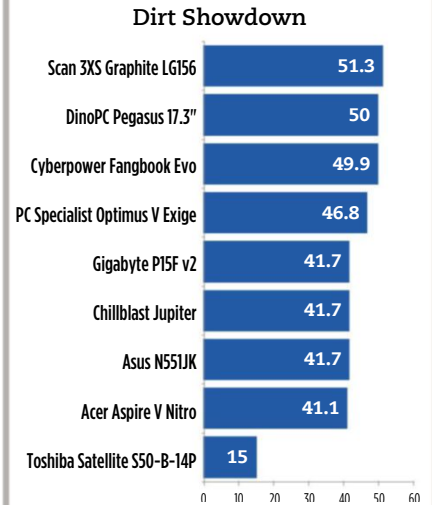
of DDR3 RAM. We have normalised all its results to 100, which makes it easy to draw comparisons. We use the same tests in all our reviews.

You can download the tests for free from <http://bit.ly/shopperbenchmarks>.

**SETTINGS** We run our application tests at native resolution and in 32-bit colour

**WEB** <http://bit.ly/shopperbenchmarks>

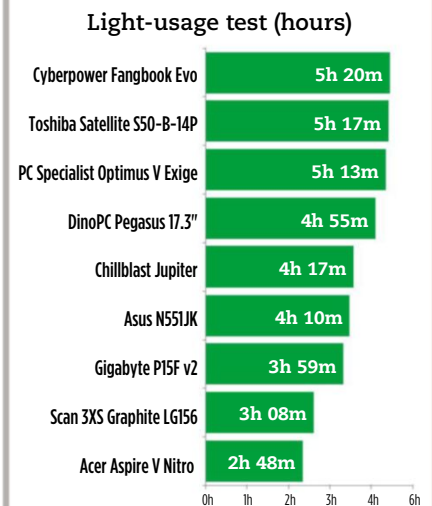
## 3D performance



Our Dirt Showdown test shows how well a laptop copes with gaming at 1080p.

**Settings** 1,920x1,080 resolution, 4x AA, Ultra detail

## Battery life



Our battery test involves light browser use with the screen at its medium brightness setting.

**Settings** Native resolution, screen at half brightness

## VERDICT

The desktop replacement laptop market is extremely competitive. Our favourite is the Acer Aspire V Nitro. It doesn't have an SSD and is a little more expensive than some, but it's very well made and portable, too.

PC Specialist's Optimus V Exige is the best-value laptop here. It has a huge SSD and great performance, but it's not pretty.

In the budget category, Asus's N551JK has a quality screen, an attractive, chunky

design and decent internal components, making it great value at £599.

Finally, Scan's 3XS Graphite LG156 is expensive, but the well-made chassis and good screen are worth the extra cash.

**ASUS** Aspire V Nitro VN7-591G

★★★★★

COMPUTER SHOPPER  
BEST BUY



**ASUS** N551JK

★★★★★

COMPUTER SHOPPER  
BEST BUY



**PC SPECIALIST** Optimus V Exige

★★★★★

COMPUTER SHOPPER  
RECOMMENDED



**SCAN** 3XS Graphite LG156

★★★★★

COMPUTER SHOPPER  
RECOMMENDED





# Get the most out of your new laptop

Intensive tasks such as video editing and gaming can put a real strain on your laptop, but with a few tweaks you can boost its performance

**ALTHOUGH OUR PC** benchmarks give you a good idea of how systems compare to each other and are a useful baseline in indicating performance, they don't give you the full picture. Here, we've looked at two intensive real-world tasks – video editing and gaming – to find out how these laptops cope with the tasks. We'll also explain how to get the most out of your new laptop by tweaking the settings to maximise its performance.

We've taken the Scan 3XS Graphite LG156, which is a fairly typical powerful laptop, and

dedicated graphics card in a laptop with two of the most demanding challenges you can throw at them: video editing and gaming.

## VIDEO EDITING

If you're an amateur video maker, producing content for friends, family or for the web, you don't need a huge desktop PC to be able to edit videos smoothly in real time, but you do need a laptop that can give you a real-time view of the video you're editing. This is very important for maintaining an efficient

We then decided to up the ante. While 4K Ultra HD consumer video cameras are still relatively uncommon and pretty expensive, action cameras such as the GoPro Hero 4 Black are available for under £400 and shoot Ultra HD video at 30fps. Again, the laptop was able to render a single stream of Ultra HD video in Preview mode without any delays.

We expected this, because it's not single video streams that are the problem when video editing. Instead, it's video effects and multiple video streams. With three Ultra HD video streams on screen at once, performance dropped slightly to around 18fps, which is still usable when editing. To really tax the system we applied a blur effect to one of the videos.

Performance was extremely slow, with the video playing at between 3fps and 8fps. However, Vegas Pro also supports GPU rendering, letting you use the dedicated graphics chip for an extra speed boost. Switching the GPU assistance over to the dedicated 860M graphics card increased performance massively: the video now played at between 15fps and 20fps. For three streams of Ultra HD video, this is impressive, and probably far beyond what most users will be looking for, since the majority of consumer camcorders and DSLRs only shoot in Full HD video, not Ultra HD.

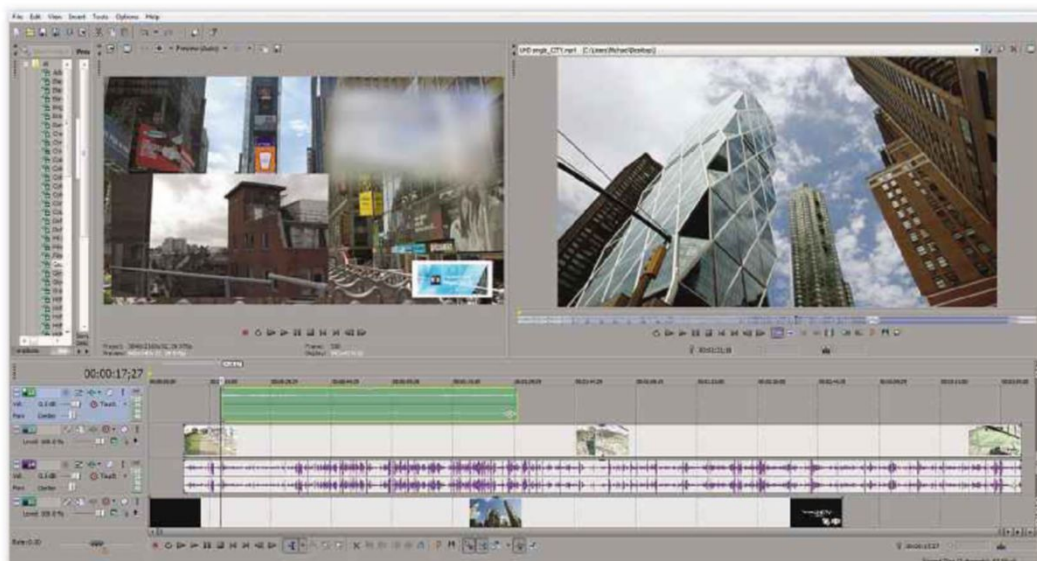
## If you're going to be using video-editing software, make sure your setup is geared towards high performance

conducted some real-world tests away from our standard benchmarks. The LG156 has a quad-core 2.5GHz Intel Core i7-4710MQ processor that can Turbo Boost to 3.5GHz when thermal conditions allow.

The LG156 comes with a 2GB Nvidia GeForce GTX 860M mid-range graphics card. Graphics cards help games look good and run smoothly, but they can also enhance performance in other applications. In our tests below, we'll show you what's possible with a

workflow and not constantly having to check that the edits you're making actually look how you intend them to.

We used our favourite video-editing software, Sony Vegas Pro 11, to test the mettle of our laptop. First, we subjected it to a standard, Full HD clip from a consumer-level camcorder. That by itself proved to be no problem for the LG156, with Sony Vegas rendering it in real-time as the video played in Preview quality mode.



▲ A desktop-replacement laptop such as Scan's 3XS Graphite LG156 can easily handle three streams of 4K video in Sony Vegas, and its dedicated graphics card helps with rendering visual effects

## BOOSTING PERFORMANCE

If you're going to be using video-editing software on your laptop, you should make sure your setup is geared towards high performance. First, make sure your laptop is set to High Performance mode in Windows Power Options. Do this by selecting the battery icon at the bottom right of the screen. If you see High Performance here, select it. If not, select More power options, then Show additional plans and select the High Performance mode.

Make sure your video footage is stored on your PC and not on a USB drive or an SD card, which would create a bandwidth problem. In your video software of choice, you should check that it has all the tools it needs to run efficiently.



↑ Crysis 3 is a very demanding game, but with careful tweaking it can run well on mid-range laptops

Make sure the amount of RAM it's allowed to use is as high as possible (leaving 2GB or 3GB to the operating system).

Finally, if your software supports GPU rendering, make sure it's switched on. As seen above, it will dramatically boost performance when you're using effects and transitions.

## GAMING

Our gaming benchmarks, particularly the Crysis 3 challenge, are tough. We put all our PCs and laptops through the same tests so that we can see how powerful each machine is relative to the others. Many laptops will struggle with the Full HD Crysis 3 test, although we'll often tell you how we were able to make the game playable by optimising the graphics settings.

In this month's group test, the most common graphics card, the Nvidia GeForce GTX 860M, requires the user to optimise their games to ensure they get the best balance of performance and graphical eye candy. Lots of games automatically apply graphics settings suitable for the hardware, but this isn't always accurate.

## DIFFERENT SETTINGS

To get the most out of games on your laptop, you should know how much of an impact your graphics settings will have on frame rates, and whether the visual gains made are worth it. This is particularly important on mid-range laptops, which have limited graphics memory and processing power.

## TEXTURE QUALITY

**Performance impact:** Low-high

**Visual impact:** High

Texture quality is relatively straightforward. The higher the quality, the more memory is required to store the textures for instant access. As long as you're not filling up your graphics card's memory, the performance change between low and high settings shouldn't be too great. However, many newer games have extremely high-resolution textures that could overstretch your graphics card. In Crysis 3, we found switching between

Medium and High texture settings only made a 2-3fps difference on our 2GB 860M chip.

## ANTI-ALIASING (AA)

**Performance impact:** High

**Visual impact:** Medium

As all laptop displays use square pixels, diagonal lines don't look smooth, but can have a stepped and jagged appearance to them. Anti-aliasing is the technology that removes the jagged appearance. There are different types of anti-aliasing, but they all have a significant impact on performance.

On a smaller Full HD screen these jagged edges are less visible, as each pixel is smaller and the jaggedness is harder to see, but if your system can handle it, you should keep AA on lower settings such as 1x or 2x. On a low-resolution screen, you may have to go to 4x to get the optimal view. In Crysis 3, the difference between 1x and 4x anti-aliasing made a difference of around 10fps.

## TEXTURE FILTERING

**Performance impact:** Medium

**Visual impact:** High

Surfaces in games are made up of textures: images that are designed to look like a

particular material, such as cobblestones. The issue is that as your viewpoint changes, the texture may not be able to be applied in the optimal fashion or size. For example, stand on a cobblestone street and the textures in the far distance will have to be resized to fit the space and angled towards the vanishing point.

This can lead to some strange effects, or textures in the distance looking blurred. Texture filtering is designed to fix this problem, giving a sharper and more realistic world view. Bilinear and trilinear filtering use older technology, and give acceptable but not the best results; anisotropic is the most advanced (and processor-intensive) method, and has to have a level of filtering applied. Generally speaking, 8x anisotropic filtering (AF) is the best option and, these days, often the only option, but test the settings until you get the desired mix between frame rate.

Testing with Crysis 3, switching between 1x anisotropic filtering and 16x made around 3fps difference. It can't be disabled in Crysis 3, and bilinear and trilinear filtering aren't supported.

## TEST YOUR PERFORMANCE

The best way to fine-tune your game's performance is to play the same section of a game repeatedly, each time tweaking a graphics setting. To do this you should run Fraps, a free piece of software that allows you to measure frame rates.

Download the software from [fraps.com](http://fraps.com). Once it's installed, select the FPS tab and make a note of the hotkey that activates its frame rate measurement tools (it's F11 by default). Open your game and play your chosen section, hitting F11 before you do so. When you're done, hit F11 again. Go back to Fraps and select the View button in the FPS tab and open the FRAPSLOG text file. This will tell you your minimum, maximum and average frame rate. Keep doing this until your average frame rate is around 40fps and your minimum frame rate is no less than 25fps. This ensures you'll have smooth gameplay no matter what's happening on the screen. ☑



↑ Fraps is a free tool that lets you benchmark your games' frame rates



	BEST BUY		BEST BUY	
	ACER		ASUS	
	Aspire V Nitro VN7-591G		N551JK	
	★★★★★		★★★★★	
	CHILLBLAST		CYBERPOWER	
	Jupiter		Fangbook Evo HX6-100	
	★★★★☆		★★★★☆	
CORE SPECIFICATIONS				
Processor	Quad-core 2.5GHz Intel Core i7-4710HQ	Dual-core 2.8GHz Intel Core i5-4200H	Quad-core 2.5GHz Intel Core i7-4710MQ	Quad-core 2.5GHz Intel Core i7-4710MQ
RAM	8GB	8GB	8GB	8GB
Memory slots (free)	2 (0)	2 (0)	2 (0)	2 (1)
Max memory	16GB	16GB	16GB	16GB
Size	389x257x24mm	383x255x32mm	374x252x31mm	383x249x37mm
Weight	2.4kg	2.7kg	2.5kg	2.6kg
Sound	Realtek HD Audio (3.5mm headset port)	Realtek HD Audio (2x 3.5mm audio ports)	Realtek HD Audio (2x 3.5mm audio ports)	Realtek HD Audio (2x 3.5mm audio ports)
Pointing device	Touchpad	Touchpad	Touchpad	Touchpad
DISPLAY				
Screen size	15.6in	15.6in	15.6in	15.6in
Screen resolution	1,920x1,080	1,920x1,080	1,920x1,080	1,920x1,080
Touchscreen	No	No	No	No
Graphics adaptor	Nvidia GeForce GTX 860M	Nvidia GeForce GTX 850M	Nvidia GeForce GTX 850M	Nvidia GeForce GTX 860M
Graphics outputs	HDMI	HDMI, Mini DisplayPort	HDMI, VGA	HDMI, VGA
Graphics memory	2GB	2GB	2GB	2GB
STORAGE				
Total storage	1TB SSHD (8GB SSD cache)	1TB hard disk	120GB SSD, 500GB SSHD (8GB SSD cache)	1TB hard disk
Optical drive type	None	DVD drive	DVD drive	DVD drive
PORTS AND EXPANSION				
USB ports	3x USB3	3x USB3	1x USB, 3x USB3	2x USB, 2x USB3
Bluetooth	Yes	Yes	Yes	Yes
Networking	802.11n (dual-band) Wi-Fi, Fast Ethernet	802.11n (dual band) Wi-Fi, Gigabit Ethernet	802.11n (dual band) Wi-Fi, Gigabit Ethernet	802.11n (dual band) Wi-Fi, Gigabit Ethernet
Memory card reader	SDXC	SDXC	SDXC	SDXC
Other ports	None	None	eSATA	None
OPERATING SYSTEM				
Operating system	Windows 8.1	Windows 8.1	Windows 8.1	Windows 8.1
Operating system restore option	Restore partition	Windows 8 restore	Windows 8 restore	Windows 8 restore
BUYING INFORMATION				
Parts and labour warranty	One year RTB	One year collect and return	Two years collect and return, five years parts and labour	One year RTB
Price inc VAT	£850	£599	£750	£800
Details	www.acer.co.uk	www.asus.com/uk	www.chillblast.com	www.cyberpowersystem. co.uk
Supplier	www.saveonlaptops. co.uk	www.amazon.co.uk	www.chillblast.com	www.cyberpowersystem. co.uk
Part number	NX.MQLEK.002	N551JK-CN073H	Jupiter	Fangbook Evo HX6-100

		RECOMMENDED	RECOMMENDED	
DINOPC	GIGABYTE	PC SPECIALIST	SCAN	TOSHIBA
Pegasus 17.3"	P15F v2	Optimus V Exige	3XS Graphite LG156	Satellite S50-B-14P
★★★★☆	★★★★☆	★★★★☆	★★★★★	★★★★☆
Dual-core 2.6GHz Intel Core i5-4210M	Quad-core 2.5GHz Intel Core i7-4710MQ	Quad-core 2.5GHz Intel Core i7-4710MQ	Quad-core 2.5GHz Intel Core i7-4710MQ	Dual-core 1.7GHz Intel Core i5-4210U
8GB	8GB	8GB	8GB	8GB
2 (0)	2 (0)	3 (2)	2 (1)	2 (1)
16GB	16GB	24GB	16GB	16GB
413x278x44mm	374x252x31mm	413x278x44mm	374x250x43mm	380x262x20mm
3.2kg	2.5kg	3.2kg	2.7kg	2.1kg
Realtek HD Audio (3x 3.5mm audio ports)	Realtek HD Audio (2x 3.5mm audio ports)	Realtek HD Audio (3x 3.5mm audio ports)	Creative Sound Blaster Cinema (3x 3.5mm audio ports)	Realtek HD Audio (3.5mm headset port)
Touchpad	Touchpad	Touchpad	Touchpad with fingerprint scanner	Touchpad
17.3in	15.6in	17.3in	15.6in	15.6in
1,920x1,080	1,920x1,080	1,920x1,080	1,920x1,080	1,920x1,080
No	No	No	No	No
Nvidia GeForce GTX 860M	Nvidia GeForce GTX 850M	Nvidia GeForce GTX 860M	Nvidia GeForce GTX 860M	AMD Radeon R7 M260
HDMI, VGA	HDMI, VGA	HDMI, VGA	HDMI, VGA	HDMI
2GB	2GB	2GB	2GB	2GB
120GB SSD, 1TB hard disk	1TB SSHD (8GB SSD cache)	240GB SSD, 1TB hard disk	120GB SSD, 1TB hard disk (Dual drive)	128GB SSD
DVD drive	DVD drive	DVD drive	DVD drive	None
1x USB, 3x USB3	1x USB, 3x USB3	1x USB, 3x USB3	2x USB, 2x USB3	1x USB, 2x USB3
Yes	Yes	Yes	Yes	Yes
802.11n Wi-Fi, Gigabit Ethernet	802.11n Wi-Fi, Gigabit Ethernet	802.11n Wi-Fi (dual band), Gigabit Ethernet	802.11ac Wi-Fi, Gigabit Ethernet	802.11ac Wi-Fi, Gigabit Ethernet
SDXC	SDXC	SDXC	SDXC	SDXC
eSATA	eSATA	eSATA	eSATA	None
Windows 8.1	Windows 8.1	Windows 8.1	Windows 8.1	Windows 8.1
Windows 8 restore	Windows 8 restore	Windows 8 restore	Windows 8 recovery	Windows 8 restore
Three years RTB including one year parts	Two years RTB	Three years RTB including one year parts	Two years RTB	One year collect and return
£799	£789	£799	£899	£615
www.dinopc.com	www.gigabyte.com	www.pcspecialist.co.uk	www.scan.co.uk/3xs	www.toshiba.co.uk
www.dinopc.com	www.saveonlaptops.co.uk	www.pcspecialist.co.uk	www.scan.co.uk	www.johnlewis.com
Pegasus 17.3"	P15F V2-CF1	Optimus V Exige	3XS Graphite LG156	PSPQ6E-04200XEN





# HARD DECISIONS

## Storage devices

This month we've tested 25 SSDs, hard disks and hybrids, so whether you need a performance boost or masses of storage, we've got a drive for you

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**CRUCIAL** MX100

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**CRUCIAL** M550

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**INTEL** 730 Series

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**PATRIOT** Blaze

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**PNY** XLR8 Pro

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**SAMSUNG** 850 Evo

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**SANDISK** Ultra II

#### HARD DISKS

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**SEAGATE** Desktop HDD

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**SEAGATE** Desktop SSHD

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**SEAGATE** Laptop SSHD

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**SEAGATE** Laptop Ultrathin

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**WD** Black

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**WD** Black<sup>2</sup> Dual Drive

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**WD** Green

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**WD** Green Mobile

**FEW THINGS HAVE** a greater impact on the performance and usefulness of a PC or laptop than its internal disk drive. Not having enough storage is immensely frustrating, as you have to uninstall programs to make room for the latest game, for example, or move some of your files to an external storage device before you can download a rented film. A slow hard disk, on the other hand, can make your computer feel sluggish, as the operating system and applications take ages to load.

Both problems can be solved with a drive upgrade. Mechanical hard disks are astounding value, providing thousands of gigabytes of storage for less than 3p a gigabyte. Meanwhile, solid-state drives (SSDs) are incredibly fast and enable a PC to boot in seconds, while adding a welcome dose of responsiveness to the operating system. Hybrid drives try to offer the best of both worlds, combining the speed of an SSD with the capacity of a mechanical hard disk.

If you're fitting a disk in a desktop PC, you don't necessarily have to choose between a hard disk and SSD, as you could use a fast SSD as your system disk, and store your files and documents on the slower hard disk. Laptops usually have room for only one drive, though, so you'll have to decide whether speed or capacity is more important – unless you fit a hybrid drive (see below). Bear in mind that some laptops don't have standard hard disk bays or won't let you upgrade the disk, so check before you buy. For a guide to upgrading the hard disk in a PC or laptop, see our upgrade feature in *Shopper 325*, or download it from [www.shopperdownload.co.uk/feature/upgradeguide.pdf](http://www.shopperdownload.co.uk/feature/upgradeguide.pdf).

## THE HARD WAY

Hard disk drives have been around for an eternity in technology terms. These provide the highest storage capacities by far, as well as being much cheaper per gigabyte of capacity than SSDs, so if you have lots of media and documents to store, a hard disk is your best option. If you use a hard disk for your operating system and applications, don't expect the same fast loading times and snappy responsiveness you'd get with an SSD, as even the slowest SSD is over three times as fast as the fastest hard disk.

Hard disks are often referred to as mechanical drives due to the way they work. Fundamentally, a hard disk consists of a mechanical arm and, depending on its storage capacity, one or more platters. The arm holds the read/write heads, which move across the platter at extremely high speeds. The platters themselves rotate at anything up to 10,000rpm. Data is stored on the surface of each platter, and the arm moves the heads over the surface to read and write data.

It's the mechanical nature of hard disks that makes them slower than SSDs, which use flash storage instead of moving parts. It's also why hard disks are more susceptible to damage – dropping a laptop with a hard disk is likely to result in data loss.

## SOLID AS A ROCK

A solid-state drive (SSD) is one of the most effective upgrades you can make to your PC and is an excellent choice for a primary system disk. With their superior read and write speeds, they can instantly make your operating system more responsive. Boot up and shut down times are significantly shorter than with a mechanical disk, and applications will typically open much faster.

SSDs are able to achieve such blistering file transfer speeds due to the lack of any moving parts. Rather than the disk platters found in hard disks, SSDs use NAND flash memory. NAND comes in a number of varieties based on how much data each of its cells can contain. The increasingly rare Single-level Cell (SLC) type can store only one bit, Multi-level Cells (MLC) can store two bits and Triple-level Cell (TLC) can store three.

By using cells that store more than one bit, manufacturers can pack more storage capacity into a smaller space, allowing SSDs to reach ever-greater capacities while still fitting in existing drive bays. There's a balance to strike, however, as using more bits per cell can compromise speed and reliability.

Other innovations have also allowed SSDs to increase in capacity, such as Samsung's 3D V-NAND system, which stacks cells both vertically and horizontally. SSDs are still behind hard disks for capacity, however, and their cost per gigabyte is also a lot higher.

A separate controller acts as an interface between an SSD's NAND modules and the operating system, and this can affect performance. Marvell is a popular controller manufacturer, and its designs can be found in many SSDs from different manufacturers.

With no moving parts, SSDs are less susceptible to impact damage and resulting data loss, so if you're prone to dropping your laptop, an SSD might be a sensible upgrade for you. All SSDs come in the 2½in form factor but, as with laptop hard disks (see below), they vary in thickness, so check your laptop's drive bay before you upgrade.

## HYBRID DRIVES

As we've mentioned, hard disk drives still provide the most storage for your money, but the read and write speeds of SSDs can't be beaten. The obvious solution, therefore, would be to combine the two. That's precisely what many manufacturers have done with their solid-state hybrid drives (SSHDs).

Many desktop PC manufacturers provide an SSD as a system disk for the operating system and software, and a secondary hard disk for media files, but this simply isn't possible in most laptops, which have a solitary drive bay. This is where an SSHD could be a good compromise.

SSHDs combine both types of storage technology in a single physical drive. Most have a large-capacity hard disk and a smaller SSD NAND cache, typically around 8GB in size. Caching algorithms then decide which data should reside on the SSD and which will go on the hard disk. Typically, the data you use most frequently, such as operating system files and software application data, will remain on the SSD cache for quick access. This means performance should improve over time as the caching algorithm learns your usage patterns. Our tests show that SSHDs make some difference to file transfers and can dramatically reduce boot times.

There are also other hybrid drive implementations, such as Western Digital's Black<sup>2</sup> Dual Drive. Instead of using an SSD as a cache, these drives package together a hard disk and an SSD in a single 2½in drive. This means you can use the smaller, faster SSD as your system disk and still have plenty of mechanical hard disk space for your files. It's an excellent solution for when you have only a single drive bay.

## ANOTHER DIMENSION

Storage drives typically come in two form factors: 2½in and 3½in. All SSDs are 2½in but mechanical hard disks can come in either size. A typical PC case will be able to accommodate both sizes, but laptops use only 2½in drives.

This is complicated slightly by the fact that not all 2½in drives are the same thickness. Most are 7mm thick, but some are available in a thinner 5mm format for use in Ultrabooks and other slim laptops, and there's also a thicker 9.5mm format, which is often seen in large desktop replacement laptops. We note how thick each drive is in our reviews, but you'll need to check which size will fit your laptop before you buy.

Thankfully, many 7mm SSDs come with a spacer that makes an SSD fit into a 9.5mm drive bay. Some drives also come with data migration kits, such as a USB-to-SATA connector and accompanying software that allows you to transfer your operating system and data across from an existing drive.

## How we test

To test the read and write speeds of each storage device, we use a script that copies files to and from the device and measures the time taken. We copy the files to the device from memory rather than from another drive, because RAM is faster than any hard disk or SSD, so it won't act as the limiting factor. In our large-file tests, we copy a 100MB file to and from each device 100 times to see how fast it is when dealing with big files such as video. We repeat the test using a selection of smaller files totalling 100MB, to see how well a drive copes with the many smaller files needed when loading an operating system or application.



## ADATA Premier SP610



£102 inc VAT (256GB), £204 inc VAT (512GB), £367 inc VAT (1TB) •  
From [www.comwales.co.uk](http://www.comwales.co.uk)

### VERDICT

The ADATA Premier SP610 is an inexpensive SSD but its performance is only average

**THE ADATA PREMIER** SP610 differs from other SSDs in that it uses a Silicon Motion controller instead of the more common type from Marvell. Silicon Motion has been around for a while, and other companies such as Corsair also use its controllers. The ADATA



Premier SP610's SM2246EN controller supports the SATA3 (6Gbit/s) interface, and has a claimed read speed of 560MB/s and write speed of 290MB/s for the 256GB model we tested. The Premier SP610 is also available in 512GB and 1TB capacities, both of which have a higher rated write speed of 450MB/s. The cost per gigabyte is about average across the capacities, at between 36p and 40p.

Like many other mid-priced SSDs, the Premier SP610 uses 20nm MLC (Multi-level Cell) NAND with an Input/Output Operations Per Second (IOPS) rating of 73,000. There isn't much in the way of included accessories, but you get a spacer to fit the 7.5mm-thick drive in a laptop with a 9.5mm drive bay. There's also a free download of Acronis True Image HD included, which will be useful for anyone who needs to migrate their Windows installation from an old disk.

The Premier SP610 did reasonably well in our benchmarks, managing 487.3MB/s in our large-file read test and 451.7MB/s in our large-file write test. This gives it an overall speed of 469.5MB/s, which is average large-file performance for the price. We sometimes saw faster large-file read speeds above 600MB/s but only occasionally. The drive's small-file performance wasn't quite as impressive, but it was still respectable. We recorded small-file read speeds of 85.7MB/s and write speeds of 99.4MB/s for an overall small-file speed of 92.6MB/s. This isn't the fastest SSD available, but it's fairly good value per gigabyte.

The ADATA Premier SP610 is a good proposition for those who don't need the absolute best performance, although it trails behind the Patriot Blaze and Crucial MX100 for overall performance. Our favourite low-cost SSD by far is the SanDisk Ultra II, however, which is only fractionally more expensive than Adata's model and provides far superior large-file performance.

### SPECIFICATIONS

#### CAPACITIES AVAILABLE

256GB/512GB/1TB

#### COSTS PER GIGABYTE

£0.40 (256GB, 512GB), £0.36 (1TB)

#### PART CODES

ASP610SS3-256GM-C

ASP610SS3-512GM-C

ASP610SS3-1TM-C

#### 256GB

Large files overall

469.5MB/s

Small files overall

92.6MB/s

See page 72 for performance details

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## CRUCIAL MX100



£92 inc VAT (256GB), £175 inc VAT (512GB) • From [uk.crucial.com](http://uk.crucial.com)

### VERDICT

The Crucial MX100 is a fantastic-value and fast SSD

**THE MX100 IS** part of Crucial's budget range of SSDs, and when it comes to performance at a low price, it's tough to beat. The MX100 is available in 256GB and 512GB capacities and has a low cost per gigabyte of around 35p.

The MX100 uses 16nm, 126Gbit/s, 2-bit MLC NAND flash from Crucial's parent company Micron. The smaller 16nm manufacturing process allows Crucial to pack

more chips into a tighter area, lowering production costs and paving the way for even higher-capacity SSDs, which goes some way to explain how Crucial is able to price the MX100 so competitively. The MX100 uses a Marvell 88SS9189 controller with custom Micron firmware.

Although the MX100 isn't available as part of an upgrade kit, it comes with a couple of extras we wouldn't expect from a budget model. There's a spacer for fitting the 7.5mm-thick SSD in a laptop with a 9.5mm drive bay, as well as a free downloadable copy of Acronis True Image HD 2014. The only critical feature this software download lacks compared with the full retail version of Acronis TrueImage is the ability to back up only the files that have changed since the last backup, which reduces the time a backup takes. Even so, the included software is useful if you need to copy files from your old hard disk to the MX100.

Crucial's MX100 SSDs are all rated as having 550MB/s read speeds, but the write



speed performance increases with each higher capacity. The 256GB drive is rated at 333MB/s and the 512GB model at 500MB/s.

We tested both models and found they performed excellently for the price. The 256GB model delivered a large-file read speed of 457MB/s and write speed of 454.4MB/s. The faster 512GB model produced a read speed of 467.5MB/s and write speed of 679.3MB/s. In our small-file tests, the 256GB disk managed a read speed of 81.9MB/s and a write speed of 98.9MB/s. The 512GB model's small-file performance was only marginally different.

The 512GB version of the MX100 is the best option if your budget allows, not only for its larger capacity but also its superior performance. Overall, the MX100 is astonishingly cheap for such a quick SSD, but it just loses out to the Sandisk Ultra II for a Best Buy award, thanks to the Ultra II's similar performance and lower cost per gigabyte.

### SPECIFICATIONS

#### CAPACITIES AVAILABLE

256GB/512GB

#### COSTS PER GIGABYTE

£0.35 (256GB/512GB),

#### PART CODES

CT256MX100SSD1

CT512MX100SSD1

#### 256GB

Large files overall

455.7MB/s

Small files overall

90.3MB/s

See page 72 for performance details

## CRUCIAL M550

COMPUTER SHOPPER

★★★★★

BEST BUY

£110 inc VAT (256GB), £200 inc VAT (512GB), £339 inc VAT (1TB) •

From [uk.crucial.com](http://uk.crucial.com), [www.kikatek.com](http://www.kikatek.com)

### VERDICT

The Crucial M550 provides exceptional performance for the money

**THE MX100 IS** Crucial's budget-friendly SSD, but the M550 is for those who would rather have extra performance. Unlike Crucial's cheaper model, the M550 is available with up to 1TB of storage. It's the successor to one of our favourite SSDs, the M500. As its name

### SPECIFICATIONS

#### CAPACITIES AVAILABLE

256GB/512GB/1TB

#### COSTS PER GIGABYTE

£0.43 (256GB), £0.39 (512GB), £0.33 (1TB)

#### PART CODES

CT256M550SSD1

CT512M550SSD1

CT1024M550SSD1

#### 256GB

Large files overall

625.7MB/s

Small files overall

90.5MB/s

See page 72 for performance details

suggests, the M550 is a fairly minor update, but any drive that improves on the excellent M500 is bound to grab our attention.

As well as the 1TB drive, you can buy 256GB and 512GB versions. All but the 1TB model are available either as a standard 2½in SATA3 disk or as mSATA DIMM-style chips for use in an Ultrabook. We tested the 2½in SATA3 version of the drive, but there shouldn't be any performance differences between the two designs.

Like the MX100, the M550 isn't available as part of an upgrade kit with cloning software, a USB-to-SATA adapter or other accessories. All these parts are widely available elsewhere, though, and at least the drive comes with a bracket for mounting the 7mm-thick SSD in a 9.5mm disk bay.

Like the M500, the M550 uses 20nm Micron NAND flash, although it adds a new Marvell 88SS9189 controller with custom Micron firmware. All the different capacities



of M550 performed comparably in our file transfer speed tests.

The 1TB model wrote large files at 617MB/s and read them at 618.2MB/s, both of which are very fast speeds. Small files were written at 100.1MB/s and read at 83.5MB/s, which is above average. The 256GB model wrote large files at 628.5MB/s and read them at 610MB/s, while in the small-file tests it produced 100MB/s write and 81MB/s read speeds, so there is little performance difference between the capacities.

The 1TB drive offers the best value, costing 33p per gigabyte, but £339 is a considerable amount of money to part with. The 512GB drive costs 39p per gigabyte and the 256GB model is 43p per gigabyte, making them both good value for such quick drives.

The M550 isn't the cheapest SSD but is still good value and has excellent file transfer performance. It wins a Best Buy award.

## INTEL 730 Series

★★★★☆

£145 inc VAT (240GB), £272 inc VAT (480GB) • From [www.morecomputers.com](http://www.morecomputers.com)

### VERDICT

The Intel 730 Series SSD has strong performance but is expensive

**THE PRICE OF** SSDs has been consistently decreasing while capacities have been increasing, so we were surprised to see that Intel's 730 Series of SSDs still offers only 240GB and 480GB capacities, especially as many rivals now offer upwards of 1TB.

The 240GB model isn't particularly good value at 60p per gigabyte. The 480GB model

is slightly better at 57p per gigabyte, but that's still distinctly more expensive than rival SSDs from companies such as SanDisk and Crucial.

Intel claims that the 730 is exceptionally fast, as it's equipped with the company's own third-generation controller with optimised firmware and 20nm NAND flash, both of which have been overclocked. This specification is an improvement over previous Intel SSDs such as the 520 series, which used older SandForce controllers. Intel also claims that the 240GB 730 Series SSD has a lifetime of around five years based on 50GB of writes per day, rising to 70GB per day for the 480GB version. This happens to coincide with Intel's limited five-year SSD warranty.

Although we can't test Intel's longevity claims, we put the 480GB 730 through our demanding file transfer benchmarks. It wrote large files at a reasonable if unspectacular 546.2MB/s and read them at a respectable 487.4MB/s for a speed of 516.8MB/s overall – a slightly below-average result.



In the small-file tests the 730 achieved 100.4MB/s write and 81.4MB/s read speeds for an average read and write result of 90.9MB/s. Again, that's slap in the middle of the spectrum for the SSDs we've reviewed.

Disappointingly, the SSD comes without a spacer for fitting the 7mm-thick drive in a 9.5mm-thick drive bay, such as those found in many big desktop-replacement laptops. This is something we'd normally expect to see, but the Intel 730 Series SSD will still fit happily in most normal-sized laptops. There are no other extras, either, such as the disk cloning software that comes with some other SSDs to make transferring your software to the new drive a little easier.

The Intel 730 Series performs reasonably well but is outclassed by the Best Buy-winning Crucial M550, which is faster and cheaper than Intel's drive.

### SPECIFICATIONS

#### CAPACITIES AVAILABLE

240GB/480GB

#### COSTS PER GIGABYTE

£0.60 (240GB), £0.57 (480GB)

#### PART CODES

SSDSC2BP240G4R5

SSDSC2BP480G4R5

#### 480GB

Large files overall

516.8MB/s

Small files overall

90.9MB/s

See page 72 for performance details



## PATRIOT Blaze



£85 inc VAT (240GB), £170 inc VAT (480GB) • From [www.yoyotech.co.uk](http://www.yoyotech.co.uk)

### VERDICT

The Patriot Blaze has quick large-file transfer speeds but its small-file performance is disappointing

**MUCH LIKE THE** Intel 730 Series of SSDs, the Patriot Blaze range has a maximum capacity of 480GB, so it isn't a great choice for those who need a lot of storage space. Lower-capacity options are available, including 60GB and 120GB models, but we wouldn't recommend that anyone buy an SSD with less than around 250GB of space.

### SPECIFICATIONS

#### CAPACITIES AVAILABLE

240GB/480GB

#### COSTS PER GIGABYTE

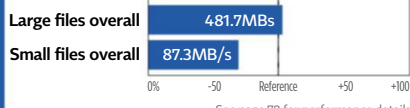
£0.35 (240GB, 480GB)

#### PART CODES

PB240GS25SSDR

PB480GS25SSDR

#### 240GB



The 240GB and 480GB models are the best choice for most people. These allow you to install an operating system as well as applications and games to benefit from the faster speeds of solid-state drives.

Both the 240GB and 480GB drives cost 35p per gigabyte, which makes the Patriot Blaze a competitor to the keenly priced Crucial MX100. Like the MX100, the Patriot Blaze uses 16nm MLC NAND, with smaller flash chips that allow more to be packed into a standard 2½in enclosure. The 16nm manufacturing process also reduces costs. The NAND is paired with a Phison PS3108-S8 controller – the same chip we've seen in other inexpensive SSDs.

Both the 240GB and 480GB drives are rated as having a 555MB/s read speed, but the 240GB model has a slightly faster rated write speed of 535MB/s compared with the 480GB model's 500MB/s. In our file transfer tests, the 240GB model delivered a relatively slow large-file write speed of 423.3MB/s but



an excellent read speed of 540MB/s. Its small-file speeds were only average, however, and the read speed of just 75.9MB/s was a particular disappointment. The small-file write speed of 98.6MB/s was more respectable.

The Patriot Blaze comes without any accessories. We weren't expecting an upgrade kit to help you transfer your data, especially considering the Blaze's very reasonable price, but we'd have liked to see a spacer included to help fit the 7mm-thick drive in laptops that have 9.5mm drive bays. You don't get any data migration software either, unlike the Crucial MX100, which comes with a copy of Acronis True Image HD 2014.

The Patriot Blaze is good value, but its slower small-file performance means it just loses out to the Crucial MX100 for a Recommended award. However, if you're looking for a budget SSD, the Best Buy-winning SanDisk Ultra II is better value than both drives.

## PNY XLR8 Pro



£155 inc VAT (240GB), £219 inc VAT (480GB) • From [www.profileit.co.uk](http://www.profileit.co.uk)

### VERDICT

The PNY XLR8 Pro isn't brilliant value and its performance left us cold

**THE XLR8 PRO** is marketed by PNY as a high-performance gaming device, but in practice it doesn't offer much to make it any better for gaming than other SSDs. It's available in 240GB and 480GB capacities, and both models use a SandForce 2281 controller. SandForce has been making SSD

### SPECIFICATIONS

#### CAPACITIES AVAILABLE

240GB/480GB

#### COSTS PER GIGABYTE

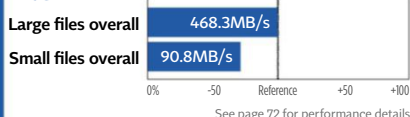
£0.65 (240GB), £0.46 (480GB)

#### PART CODES

SSD9SC240GCDA-RB

SSD9SC480GCDA-RB

#### 240GB



controllers for a long time, and is now owned by Seagate after an acquisition in mid-2014. The SandForce controller is paired with 25nm MLC NAND flash memory. At 65p per gigabyte for the 240GB drive and 46p per gigabyte for the highest-capacity 480GB drive, the XLR8 Pro range is poor value.

You don't get much in the way of bundled accessories or software either, so you should factor this in if you need an application to help you transfer your system and files from an old hard disk. It's also worth bearing in mind that the XLR8 Pro is 9.5mm thick, so it won't fit in a laptop that has a 7mm drive bay. PNY includes a very short SATA cable with the drive, which might not be long enough for your desktop PC, depending on how your motherboard is configured.

PNY rates all the drives in its XLR8 Pro SSD range as having read speeds of 550MB/s and write speeds of 520MB/s, with a high Input/Output Operations Per Second (IOPS)



rating of 85,000, which indicates that the drive should have good response times. The performance of the drives in our benchmarks left us underwhelmed, however. The 240GB model managed 464.4MB/s in our large-file read test, which is about average, and a below-average 472.2MB/s in the large-file write test. This is only fractionally faster than cheaper drives such as Crucial's MX100 and is significantly slower than SanDisk's Ultra II.

The XLR8 Pro's small-file performance was more respectable, though. It wrote small files at a slower-than-average 97MB/s, but its small file read speed was quick at 84.6MB/s.

Despite its great small-file read speeds, the PNY XLR8 Pro isn't particularly quick overall or very good value. You're much better off with the faster, better-value SanDisk Ultra II.

## SAMSUNG 850 Evo



£110 inc VAT (250GB), £198 inc VAT (500GB), £360 inc VAT (1TB) •  
From [www.ebuyer.com](http://www.ebuyer.com)

### VERDICT

Samsung's 3D V-NAND technology makes the 850 Evo a top performer

**WE WERE FANS** of Samsung's 840 Evo series of solid-state drives, as they were the first models we'd seen that came in capacities of up to 1TB. The 850 Evo is the follow-up, and uses Samsung's new 3D V-NAND technology.

This refers to the way the cells in the Evo 850's NAND flash chips are stacked vertically and horizontally, allowing Samsung to offer



greater storage capacities without shrinking the manufacturing process, which is becoming increasingly difficult. These chips use a 40nm process rather than the 20nm process more commonly seen in other manufacturers' SSDs.

Although 3D V-NAND should pave the way for higher-capacity SSDs, the 850 Evo range still offers a maximum storage capacity of 1TB. Samsung claims that 3D V-NAND reduces cell-to-cell interference, which will help the cells last longer, and the technology should lead to higher capacities in the future.

All the SSDs in the 850 Evo range use Samsung MGX controllers except for the 1TB model, which uses a Samsung MEX model. We tested the 250GB, 500GB and 1TB versions, and the performance was almost identically impressive across all the drives.

The 250GB drive achieved an astonishing large-file write speed of 713.5MB/s in our tests. Its large-file read speed was less impressive but still above average at 473.5MB/s. The 1TB drive managed a similar write speed of 712.9MB/s, and 465.3MB/s in

the large-file read test. In our small-file test the 1TB drive was the quickest model, with 99.8MB/s write and 91.2MB/s read speeds. Overall, the small-file speeds were about average for all three drive capacities.

None of the drives comes with an upgrade kit, and it's not available as an optional bundle either. Samsung doesn't even include a spacer to help fit the 7mm thick drive in a 9.5mm laptop drive bay, but at least it provides Samsung Data Migration and Samsung Magician software. The former makes it easy to clone an existing drive, but you might have to use your own SATA-to-USB cable if you don't have a spare SATA cable. Samsung Magician provides a number of useful tools for optimising the disk drive, upgrading the firmware and monitoring the drive's health. The software is easy to use.

The 850 Evo's large-file write speeds are slower than the Crucial M550's. The disks in Crucial's range are slightly cheaper per gigabyte and are also faster overall, making them our Best Buy performance SSDs.

### SPECIFICATIONS

#### CAPACITIES AVAILABLE

250GB/500GB/1TB

#### COSTS PER GIGABYTE

£0.44 (250GB), £0.40 (500GB), £0.35 (1TB)

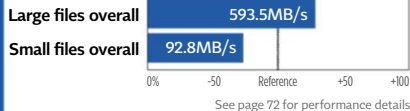
#### PART CODES

MZ-75E250BW

MZ-75E500BW

MZ-75E1T0BW

#### 250GB



## SANDISK Ultra II



£95 inc VAT (240GB), £165 inc VAT (480GB), £314 inc VAT (960GB) •  
From [www.ebuyer.com](http://www.ebuyer.com), [www.mobymemory.co.uk](http://www.mobymemory.co.uk)

### VERDICT

The SanDisk Ultra II is a fast and great-value SSD

**FEW SOLID-STATE** drives can rival Crucial's MX100 for value, but the SanDisk Ultra II range has managed just that. With prices that equate to 40p per gigabyte for the 240GB drive, 34p per gigabyte for the 480GB model and a reasonable 33p per gigabyte for the

960GB version, the SSDs in the Ultra II range are very good value.

The 240GB version of the Ultra II uses a Marvell 88SS9190 controller, while the higher-capacity disks use a Marvell 88SS9189. Crucial also uses the latter controller for its MX100 and M550 SSDs. All the Ultra II drives are built with SanDisk's 19nm TLC flash memory, which can store three bits of data per cell instead of the two in MLC NAND. This means more data can be stored in the same area, allowing for more capacious SSDs.

The Ultra II has a SATA3 connector and is 7.5mm thick, so it will fit in laptops with slim drive bays. A spacer is included for fitting the drive in laptops with 9.5mm drive bays.

No data migration software is bundled with these SSDs as such, but SanDisk's SSD Dashboard software is available as a free download. This helps you monitor and maintain your drive's health and performance as well as install any firmware upgrades.



SanDisk sent us the 240GB model to put through our benchmark tests. We found its data transfer speeds excellent for such an inexpensive drive. In our large-file test it read files at 454.4MB/s, which is about average, but it was able to write large files at an impressive 617.7MB/s, making the Ultra II a top performer for a budget drive. Its small-file performance was reasonable too, with a read speed of 77MB/s and a write speed of 97.5MB/s. That's not quite up to the standard of Crucial's MX100, but it's not far off.

For a long time, Crucial's MX100 was the obvious SSD to buy for those on a tight budget, but now the SanDisk Ultra II has stolen its crown. The 240GB model is reasonably priced, but the 960GB version offers the best value at just 33p per gigabyte.

### SPECIFICATIONS

#### CAPACITIES AVAILABLE

240GB/480GB/960GB

#### COSTS PER GIGABYTE

£0.40 (240GB), £0.34 (480GB), £0.33 (960GB)

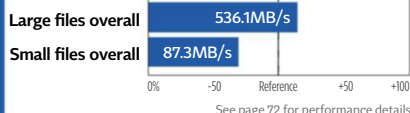
#### PART CODES

SDSSDHII-240G-G25

SDSSDHII-480G-G25

SDSSDHII-960G-G25

#### 240GB





## SEAGATE Desktop HDD



£63 inc VAT (2TB), £84 inc VAT (3TB), £112 inc VAT (4TB) • From [www.ebuyer.com](http://www.ebuyer.com)

### VERDICT

The Seagate Desktop HDD isn't particularly quick but it's good value for the largest capacities

**THE SEAGATE DESKTOP** HDD range goes all the way up to 4TB, which should provide ample space for the even the largest media collections. It's also available in 2TB and 3TB capacities. Whichever capacity you choose you'll pay 3p per gigabyte, so you might as well opt for the largest capacity you can afford.

### SPECIFICATIONS

#### CAPACITIES AVAILABLE

2TB/3TB/4TB

#### COSTS PER GIGABYTE

£0.03 (2TB, 3TB, 4TB)

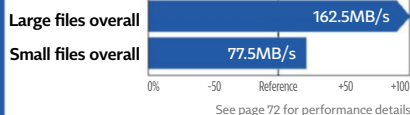
#### PART CODES

ST2000DM001

ST3000DM001

ST4000DM000

#### 4TB



Our prices are for the OEM versions. Retail kits are slightly more expensive but include mounting screws, a SATA cable and a Molex-to-SATA power adaptor. Seagate also offers its Desktop HDD in smaller capacities, but we've excluded those as they're poor value in comparison.

These drives were formerly part of Seagate's Barracuda range but have since been rebranded as the Desktop HDD range. They are standard 3½in devices and have 64MB of cache and a SATA3 controller, although plugging a mechanical hard disk into a SATA2 port is unlikely to affect its speed. The 5,900rpm spindle speed of the 4TB drive is relatively slow, but Seagate says this means the drive runs cooler than faster models.

Seagate sent us the 4TB disk to review.

Its performance in our tests wasn't the best we've seen. We didn't expect this disk to rival the speed of an SSD or SSHD hybrid drive, but its performance was even short of other mechanical disks we've tested. In



our large-file benchmark, the Desktop HDD wrote files at 168MB/s and read them at 157MB/s for an average score of 162.5MB/s, making this one of the slower mechanical hard disks we've seen. Small files were written at 73.9MB/s and read at 75.7MB/s for an average of 77.5MB/s, which still isn't amazing but is closer to the competition.

The drive is still more than quick enough as a secondary disk to store your documents and media files, but you'll notice its slow performance if you use it as a main disk for your operating system and programs.

The 4TB Seagate Desktop HDD was a below-average performer in our speed tests, which wasn't entirely surprising considering its relatively slow spindle speed. It's an inexpensive drive if you need a vast amount of space, so it would be a good choice as a secondary drive for storing your documents and media. However, Western Digital's 4TB Green 3½in drive is a similar price and has significantly better performance.

## SEAGATE Desktop SSHD



£59 inc VAT (1TB), £84 inc VAT (2TB), £135 inc VAT (4TB) • From [www.scan.co.uk](http://www.scan.co.uk)

### VERDICT

A great-value hybrid drive, but its speeds weren't as impressive as we'd hoped

**SEAGATE'S DESKTOP SSHD** was one of the first 3½in desktop hybrid drives. Hybrid drives are an attempt to combine the speed benefits of an SSD and the large capacity of a mechanical hard disk by adding a small amount of NAND flash memory to speed up access times for frequently used files.

### SPECIFICATIONS

#### CAPACITIES AVAILABLE

1TB/2TB/4TB

#### COSTS PER GIGABYTE

£0.06 (1TB), £0.04 (2TB), £0.03 (4TB)

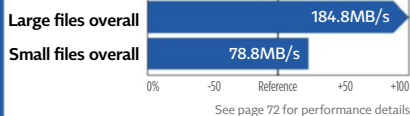
#### PART CODES

ST1000DX001

ST2000DX001

ST4000DX001

#### 4TB



Seagate's adaptive memory technology learns the user's data access patterns and adds the most frequently used data to the solid-state memory to speed up the system. The 4TB Seagate Desktop SSHD we tested is equipped with 8GB of MLC NAND and 64MB of cache, and spins at 5,900rpm.

The Desktop SSHD range also includes 1TB and 2TB versions, and these have faster spindle speeds of 7,200rpm. At 3p per gigabyte for 4TB, 4p for the 2TB disk and 6p for the 1TB model, the disks offer good value but cost a little more than Seagate's Desktop HDD and Western Digital's Green drives.

Seagate sent us the 4TB model to test, but the 2TB and 1TB models should be slightly quicker due to their faster spin speeds. In our tests the Desktop SSHD delivered respectable rather than spectacular performance. Its large file write speed of 193.9MB/s was good, and similar to that of Western Digital's Green 4TB disk, but its 175.7MB/s read speed was far behind WD's disk. Small file transfer speeds

of 79.9MB/s write and 77.6MB/s read are fine, but nothing special.

To see if the cache made any difference to Windows boot times, we used the Bootracer utility. The first run with the SSHD took 42 seconds. However, the second run dropped to 29.5 seconds and the third fell to 22.9 seconds as the SSHD cached frequently used files.

Boot times aside, the Seagate Desktop SSHD's performance is no better than that of a standard 3½in drive such as one of Western Digital's Green range. A 3½in SSHD is a tricky compromise too, as most desktop PC cases have multiple drive bays, so a better combination would be to use an SSD for your operating system and software and a hard disk for your media. SSHDs make more sense for laptops, which are limited to one drive bay.

If you don't want the hassle of having your OS and files on different disks, and value fast boot times, the Seagate Desktop SSHD could be for you. For everyone else the Western Digital Green range is a better bet.



## SEAGATE Laptop SSHD

COMPUTER  
SHOPPER  
RECOMMENDED



£68 inc VAT (1TB) • From [www.scan.co.uk](http://www.scan.co.uk)

### VERDICT

Seagate has an SSHD for every size of laptop

**SEAGATE'S LAPTOP SSHD** hybrid drive combines a hard disk with 8GB of flash memory to combine the storage space of a mechanical disk with some of the speed of an SSD. The drives are available in a range of thicknesses. The 7mm size (ST500LM000) will support most laptops, but there's also a 9.5mm (ST1000LM014) drive for large desktop-replacement laptops and a super-slim 5mm drive (ST500LX012) for Ultrabooks.

### SPECIFICATIONS

#### CAPACITIES AVAILABLE

1TB

#### COSTS PER GIGABYTE

£0.07 (1TB)

#### PART CODES

ST1000LM014

#### 1TB

Large files overall

133MB/s

Small files overall

87.7MB/s

See page 72 for performance details

The 7mm and 5mm drives are available in 500GB capacities, while the 9.5mm drive goes up to 1TB. This works out at 7p per gigabyte, which is good value. The 1TB drive has four heads and two platters, which explains its thickness. It operates at 5,400rpm, which is typical for most laptop disks.

All Laptop SSHD models have an 8GB cache of MLC NAND flash memory. The SSHD's controller uses an algorithm to learn which files you use most often and moves them to the NAND flash for faster access. It doesn't require any drivers, so it should work in Mac and Linux laptops as well as Windows.

Seagate sent us the 1TB model to review. Its performance overall in our benchmarks was excellent. The drive wrote large files at 132.1MB/s and read them at 133.9MB/s – the write speed in particular is one of the best we've seen from a laptop disk. Its small-file speeds were also good, with a 82.7MB/s write and a huge 92.7MB/s read speed, making an average of 87.7MB/s. This is the best small-file speed we've seen from any 2½in or 3½in disk.



Due to the way the cache works, we expected subsequent test runs to show even faster speeds, but even after four or five runs we saw no improvement. The technology came into its own when booting into Windows, though. When we first measured it using the Bootracer utility, the Laptop SSHD booted into Windows in 50.7 seconds. This dropped to 44 seconds for the second run, and once we'd restarted six times the cache had reduced the boot time to just 28 seconds.

It may cost more than other laptop hard disks, such as the Western Digital Green Mobile, but the fast Seagate Laptop SSHD is a solid upgrade if your laptop's existing storage is a slow mechanical hard disk. Hybrid drives make a lot more sense in laptops, where you're limited to one storage disk, and are a good compromise if you need plenty of capacity and don't want to spend a lot more on a high-capacity SSD. With the added benefit of the faster boot times and general overall responsiveness, the Seagate Laptop SSHD is a fine upgrade choice.

## SEAGATE Laptop Ultrathin



£54 inc VAT (500GB) • From [www.ebuyer.com](http://www.ebuyer.com)

### VERDICT

The Seagate Laptop Ultrathin could give your Ultrabook plenty of extra capacity, but its performance is disappointing

**ULTRA-THIN LAPTOPS**, such as Ultrabooks, can be difficult to upgrade. Many don't even let you upgrade the disk at all, and some of those that do have drive bays that are too shallow for a standard 7mm-thick 2½in disk. This is where ultra-thin 5mm hard disks such as Seagate's Laptop Ultrathin come in.

Although thin, the disk is a standard laptop model in terms of mounting points and

interface, so you may be able to use it in 2½in drive bays that support 7mm and 9.5mm drives. In contrast, some ultra-thin drives from manufacturers such as Western Digital have proprietary connectors so are really only suitable for manufacturers to build into their laptops. Many thicker drives offer better value, though, so we'd only recommend getting this drive if you really can't use a thicker one. The Ultrathin weighs 93g, too, which may be important if you want to keep your Ultrabook light.

With room for only a single disk platter, the Laptop Ultrathin range has a maximum capacity of 500GB. Larger capacities would require a second platter and would make the disk too thick. The 500GB version works out at 11p per gigabyte, which is quite expensive for a mechanical hard disk.

The Ultrathin has 16MB of cache and a spindle speed of 5,400rpm, which is standard for all but the fastest laptop drives. The Ultrathin's overall performance in our



benchmarks was decidedly underwhelming. It wrote large files at 100.8MB/s and read them at 106.7MB/s, giving it an average transfer speed of just 103.8ms. That's one of the slowest results we've seen recently. The drive was also slow at writing small files, with a score of 66.9MB/s putting it near the bottom of the laptop hard disk pack. It was quicker at reading small files, managing 78.3MB/s, which led to a more respectable – if still below-average – 72.6MB/s overall in the small-file transfer test.

There's little reason to buy the Ultrathin drive unless you explicitly need an ultra-slim model. Its performance is eclipsed by other larger drives, and its cost per gigabyte is far higher, making it poor value.

If your laptop is able to accommodate standard 7mm-thick 2½in drives, we'd recommend the Seagate Laptop SSHD instead, thanks to its faster overall performance and boot times.

### SPECIFICATIONS

#### CAPACITIES AVAILABLE

500GB

#### COSTS PER GIGABYTE

£0.11

#### PART CODES

ST500LT032

#### 500GB

Large files overall

103.8MB/s

Small files overall

72.6MB/s

See page 72 for performance details



## WESTERN DIGITAL Black



£51 inc VAT (500GB), £64 inc VAT (1TB), £102 inc VAT (2TB), £177 inc VAT (4TB) •  
From [www.ebuyer.com](http://www.ebuyer.com)

### VERDICT

**Strong performance for a mechanical hard disk and plenty of storage for not much cash**

**THE BLACK RANGE** of 3½in desktop drives is Western Digital's performance series. Each drive has a 7,200rpm spindle speed and 64MB cache. Other hard disks, such as Seagate's Desktop HDD range, have slower speeds for their higher-capacity models, but although



### SPECIFICATIONS

#### CAPACITIES AVAILABLE

500GB/1TB/2TB/4TB

#### COSTS PER GIGABYTE

£0.10 (500GB), £0.06 (1TB), £0.05 (2TB), £0.04 (4TB)

#### PART CODES

WD5003AZEX

WD1003FZEX

WD2003FZEX

WD4003FZEX

#### 4TB

Large files overall

282MB/s

Small files overall

76.4MB/s

See page 72 for performance details

you pay a premium for the faster speeds, the Black range still provides good value. It's available with 500GB, 1TB, 2TB and 4TB and, as usual, the large capacities provide the best value. The 4TB drive works out at just 4p per gigabyte, while the 500GB model is 10p. We feel the 500GB model isn't worth buying, as the 1TB model is only around £10 more.

Western Digital sent us the 1TB and 4TB models to test, and there was a fair difference between them in our tests. The 4TB model managed 237.2MB/s when writing and 326.7MB/s when reading large files, which is exceedingly quick for a mechanical drive. The 1TB drive was slightly slower, writing at 231.2MB/s and reading at 281.9MB/s, for an overall score of 256.6MB/s.

In the small-file test the standings were reversed. We measured a small-file write speed of 84.8MB/s and read speed of 68MB/s from the 4TB drive, but the 1TB drive performed better, with a 91MB/s write and

82MB/s read speed for an average of 86.5MB/s – 10MB/s faster than the 4TB drive.

The Western Digital Black is certainly good value considering its strong performance, but if you're looking for a secondary mechanical hard disk for your media, and are pairing it with an SSD, it might be overkill.

If you'll only use the Western Digital Black as a media drive to access movies and music, you won't feel the benefits of the additional speed. In that case it might be worth saving some money and opting for a cheaper hard disk such as one from Western Digital's Best Buy-winning Green range instead. The Green drives aren't far off for overall speed, and you could put the money you'd save towards an SSD to use as a system disk.

If, on the other hand, you need a secondary drive to store data such as 4K video files for editing, the Western Digital Black comes into its own, especially the 4TB model with its fast large file transfer speeds.

## WESTERN DIGITAL Black<sup>2</sup> Dual Drive



£160 inc VAT (1TB + 120GB SSD) • From [www.ebuyer.com](http://www.ebuyer.com)

### VERDICT

**The Western Digital Black<sup>2</sup> is a clever combination of a hard disk and SSD all in a single 2½in form factor**

**AT FIRST GLANCE**, the Black<sup>2</sup> Dual Drive looks like a standard 2½in hard disk, but it's actually two disks in one, with both a 1TB hard disk and 120GB SSD in the same shell. Unlike other hybrid drives, the Black<sup>2</sup> doesn't use the SSD as a cache. Its just two drives in a case with one SATA3 interface.

Conveniently, the Black<sup>2</sup> comes with a couple of extras to help you install the drive in



your computer. A USB3-to-SATA adaptor and a downloadable edition of Acronis True Image that only works with the Black<sup>2</sup> will help you clone your PC's existing Windows installation to the SSD. At 9.5mm, the drive is deeper than most SSDs or laptop hard disks, so if you plan to fit it in a laptop, check that your drive bay is big enough.

You don't need Acronis True Image if you reinstall Windows from scratch, but the software driver is essential. Without it, only the 120GB SSD will be visible to Windows. The driver is compatible with Windows 8.1 and Windows versions as old as XP, and the drivers are included on a USB flash drive.

The Black<sup>2</sup>'s SSD uses 20nm NAND flash and a JMicron JMF667H controller. The 1TB hard disk has a spindle speed of 5,400rpm and 64MB of cache. As the drives are separate, we ran each through our benchmarks. In our large files test, the 120GB SSD wrote files at 216.2MB/s and read them at 394.9MB/s, for an overall score of 305.6MB/s. These are very

slow speeds for a modern SSD. Small-file performance was also average at 93.3MB/s for writing and 79.2MB/s for reading.

The 1TB hard disk was more impressive for a mechanical disk, with a large-file read speed of 196.6MB/s and a write speed of 112.3MB/s. That's great for a 2½in hard disk, but the small-file write speed of 37.9MB/s is poor. If you're using your disk mainly to store media files, however, this shouldn't be a problem. Small-file performance is more important for loading programs and the operating system.

Since its launch, the Black<sup>2</sup> has fallen in price to the point where it costs £0.14 per gigabyte in total, which isn't cheap. If you want the speed of an SSD for your software and operating system, 120GB should be just enough space. That leaves you with a generous 1TB for your media, making the Black<sup>2</sup> a good upgrade for a laptop's storage capacity. Just make sure its 9.5mm thickness will fit in your computer.

### SPECIFICATIONS

#### CAPACITIES AVAILABLE

1TB + 120GB SSD

#### COSTS PER GIGABYTE

£0.14

#### PART CODES

WD1001X06XDTL

HDD SSD

Large files overall

154.5MB/s

305.6MB/s

Small files overall

52.3MB/s

86.3MB/s

See page 72 for performance details

## WESTERN DIGITAL Green

COMPUTER SHOPPER

★★★★★

BEST BUY

£40 inc VAT (500GB), £43 inc VAT (1TB), £64 inc VAT (2TB),  
£82 inc VAT (3TB), £118 inc VAT (4TB) • From [www.scan.co.uk](http://www.scan.co.uk)

### VERDICT

Great performance for a budget price makes the Western Digital Green hard disk range a Best Buy

**WESTERN DIGITAL'S GREEN** series of 3½in desktop hard disks offers a great combination of low price and impressive performance. It's difficult to judge exactly what makes the drives perform so well, as Western Digital is

secretive about some of the specifications. Rather than list a spindle speed, Western Digital describes its Green disks as using 'IntelliPower'. According to the company, this is a set of algorithms that manage spin speed, transfer rate and caching to deliver power savings and improve performance.

The Western Digital Green range is available in 500GB, 1TB, 2TB, 3TB and 4TB capacities, so there are plenty of options. The cost per gigabyte for the larger capacities is a very reasonable 3p for 4TB, 3TB and 2TB versions and 4p for 1TB, making them close rivals to the Seagate Desktop range for price. The 500GB drive is only £3 less than the 1TB model, so isn't really worth buying.

We tested the 4TB and 1TB models and both performed remarkably well considering their low price. The 4TB version managed a read speed of 256.9MB/s and a write speed of 195.6MB/s in our large-file test. The 1TB model performed similarly, managing read



speed of 255MB/s and a write speed of 201.1MB/s. These large-file scores are above average for mechanical hard disks.

In the small-files test the 1TB model wrote at a strong 85MB/s, but the 4TB drive managed a huge 92MB/s, which is the best we've seen from such a large drive. The 4TB drive read small files at 73.2MB/s, which again was quicker than the 1TB disk's 65.3MB/s. Considering the low price of the drives, we're seriously impressed with their performance.

If you're looking for a secondary drive to store your media, the higher-capacity drives in Western Digital's Green range offer a great price per gigabyte, and they're quick enough to use as large system disks, too. Anyone who needs to work with a lot of large files, such as when editing video, should consider the Western Digital Black range instead with its superb large-file performance, but for most people the Western Digital Green series is the Best Buy.

### SPECIFICATIONS

#### CAPACITIES AVAILABLE

500GB/1TB/2TB/3TB/4TB

#### COSTS PER GIGABYTE

£0.08 (500GB), £0.04 (1TB), £0.03 (2TB, 3TB, 4TB)

#### PART CODES

WD5000AZRX

WD10EZRX

WD20EZRX

WD30EZRX

WD40EZRX

#### 4TB

Large files overall

226.3MB/s

Small files overall

82.6MB/s

0% -50 Reference +50 +100  
See page 72 for performance details

## WESTERN DIGITAL Green Mobile

★★★★☆

£102 inc VAT (1.5TB), £107 inc VAT (2TB) • From [cpc.farnell.com](http://cpc.farnell.com), [www.scan.co.uk](http://www.scan.co.uk)

### VERDICT

The Western Digital Green Mobile has reasonable speeds but is limited by its form factor

**ALTHOUGH 2½IN DISK** drives are commonly used for laptops, Western Digital's 2½in Green Mobile hard disk drive is not intended for such use. This is because, with a thickness of 15mm, it simply won't fit in laptop bays that typically accept 5mm, 7mm or 9.5mm drives.

Instead, despite its name, the Western Digital Green Mobile is designed for use in a

desktop PC or custom enclosure. Its smaller 2½in form factor is more often seen in all-in-one desktop PCs, so if you need to upgrade your all-in-one's internal storage, it's worth checking whether yours takes 2½in or 3½in drives. Most regular PC cases will also accept the 2½in drive in any slots designed for SSDs. The Green Mobile is available in either 2TB or 1.5TB capacities, which cost 5p and 7p per gigabyte respectively.

The appeal of these thicker 2½in hard disks is that they typically generate less heat and are more power-efficient than typical 3½in hard disks. Like Western Digital's 3½in Green hard disk range, the 2½in Green disks use Western Digital's 'IntelliPower' and 'IntelliSeek' technologies, which help reduce the disk's power consumption and the level of vibration as the disk spins up and down.

The Green Mobile uses a conventional SATA3 connector and has 8MB of cache. If you need to transfer data from an existing drive, you'll be pleased to hear that Acronis



True Image WD Edition is available as a free download from Western Digital's website and works with any Western Digital drive.

The 1.5TB and 2TB versions we tested performed similarly. In our large-file read test, the 1.5TB disk managed a speed of 135.6MB/s while the 2TB drive managed 144.2MB/s. Write speeds were 103.6MB/s for the 1.5TB and 113.3MB/s for the 2TB disk, meaning the 2TB drive was fractionally faster overall. In our small-files test the 1.5TB disk read at 65MB/s and the 2TB drive at 65.9MB/s. Write speeds were 79.9MB/s for the 1.5TB disk and 83.7MB/s for the 2TB version, which are above average for a 2½in hard disk.

Western Digital's Green Mobile range performed very well overall, and the price per gigabyte is competitive. If you don't specifically need a 2½in disk, however, Western Digital's Green disks are better value and offer higher capacities and performance.

### SPECIFICATIONS

#### CAPACITIES AVAILABLE

1.5TB/2TB

#### COSTS PER GIGABYTE

£0.07 (1.5TB), £0.05 (2TB)

#### PART CODES

WD15NPVX

WD20NPVX

#### 1.5TB

Large files overall

119.6MB/s

Small files overall

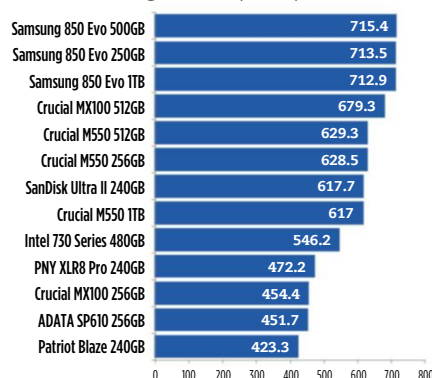
72.5MB/s

0% -50 Reference +50 +100  
See page 72 for performance details

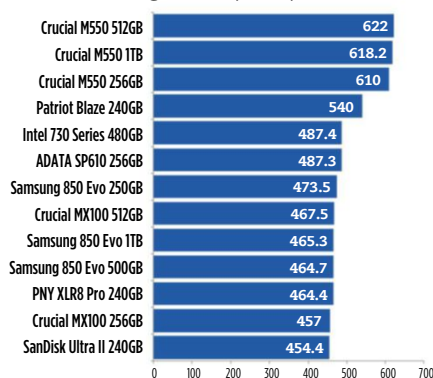


## SSD Benchmarks

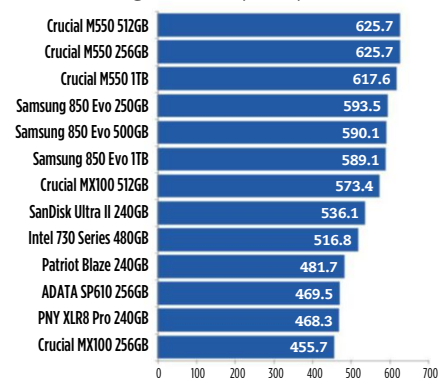
Large write (MB/s)



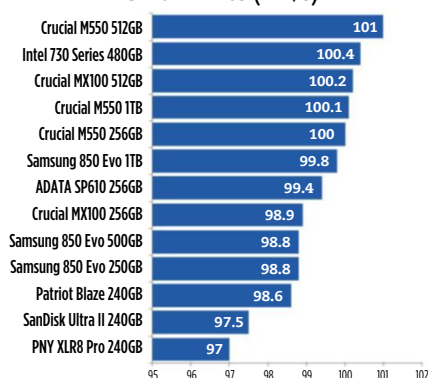
Large read (MB/s)



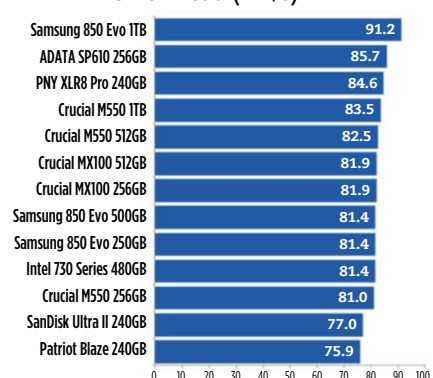
Large overall (MB/s)



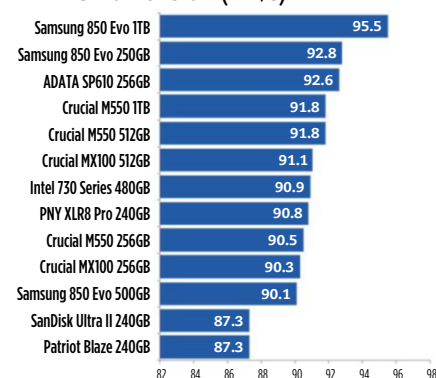
Small write (MB/s)



Small read (MB/s)

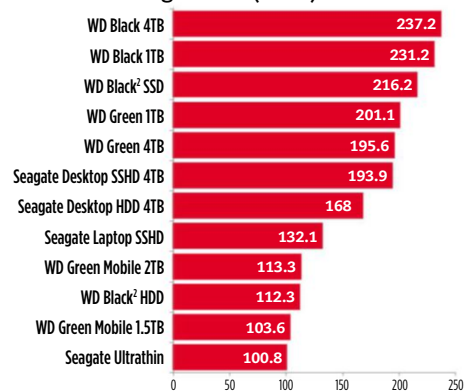


Small overall (MB/s)

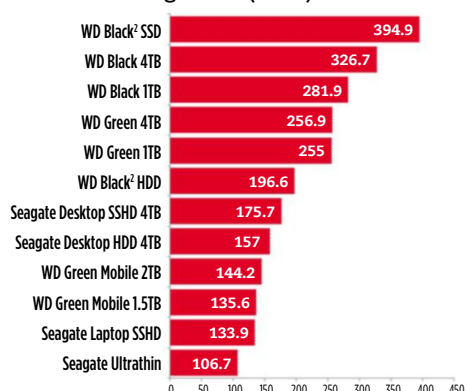


## HDD Benchmarks

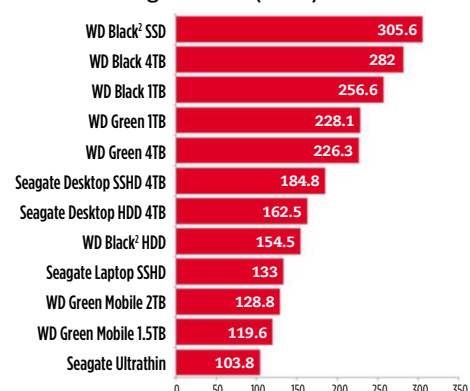
Large write (MB/s)



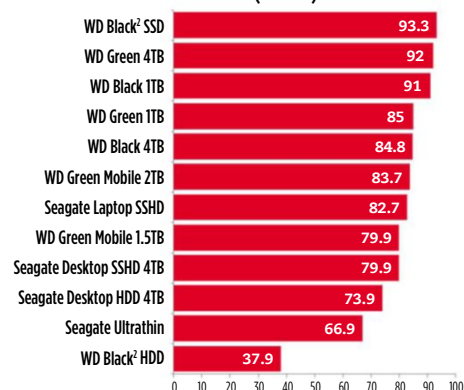
Large read (MB/s)



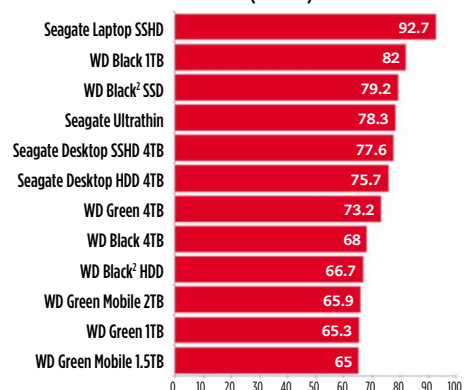
Large overall (MB/s)



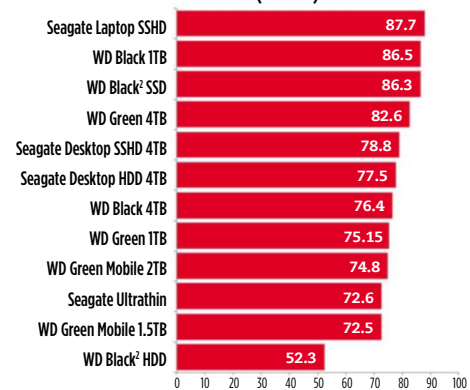
Small write (MB/s)



Small read (MB/s)



Small overall (MB/s)



## SSDs

		RECOMMENDED	BEST BUY					BEST BUY
	ADATA	CRUCIAL	CRUCIAL	INTEL	PATRIOT	PNY	SAMSUNG	SANDISK
	Premier SP610	MX100	M550	730 Series	Blaze	XLR8 Pro	850 Evo	Ultra II
Rating	★★★★☆	★★★★☆	★★★★★	★★★★☆	★★★★☆	★★★★☆	★★★★☆	★★★★★
HARDWARE								
Capacity	256GB/512GB/1TB	256GB/512GB	256GB/512GB/1TB	240GB/480GB	240GB/480GB	240GB/480GB	250GB/500GB/1TB	240GB/480GB/960GB
Cost per gigabyte	£0.40 (256GB), £0.36 (512GB), £0.36 (1TB)	£0.36 (256GB), £0.34 (512GB)	£0.43 (256GB), £0.39 (512GB), £0.33 (1TB)	£0.60 (240GB), £0.57 (480GB)	£0.35 (240GB), 480GB)	£0.65 (240GB), £0.46 (480GB)	£0.44 (250GB), £0.40 (500GB), £0.35 (1TB)	£0.40 (240GB), £0.34 (480GB), £0.33 (960GB)
Interface	SATA3	SATA3	SATA3	SATA3	SATA3	SATA3	SATA3	SATA3
Claimed read	560MB/s	550MB/s	550MB/s	550MB/s	555MB/s	550MB/s	540MB/s	550MB/s
Claimed write	290MB/s (256GB), 450MB/s (512GB, 1TB)	333MB/s (256GB), 500MB/s (512GB)	500MB/s	470MB/s (480GB), 270MB/s (240GB)	533MB/s (240GB), 500MB/s (480GB)	520MB/s	520MB/s	500MB/s
Controller	Silicon Motion SM2246EN	Marvell 88SS9189	Marvell 88SS9189	Intel third generation	Phison PS3108-S8	SandForce 2281	Samsung MGX Controller (250GB, 500GB), Samsung MEX Controller (1TB)	Marvell 88SS9190/88SS9189
NAND flash type	20nm MLC	19nm MLC	20nm MLC	20nm MLC	16nm MLC	25nm MLC	40nm 3D V-NAND	19nm TLC
Mounting kit	No	No	No	No	No	No	No	No
BUYING INFORMATION								
Warranty	Three years RTB	Three years RTB	Three years RTB	Five years RTB	Three years RTB	Three years RTB	Five years RTB	Three years RTB
Prices	£102 (256GB), £204 (512GB), £367 (1TB)	£92 (256GB), £175 (512GB)	£110 (256GB), £200 (512GB), £339 (1TB)	£145 (240GB), £272 (480GB)	£85 (240GB), £170 (480GB)	£155 (240GB), £219 (480GB)	£110 (250GB), £198 (500GB), £360 (1TB)	£95 (240GB), £165 (480GB), £314 (960GB)
Supplier	www.comwales.co.uk	uk.crucial.com	www.ebuyer.com, www.kikatek.com	www.morecomputers.com	www.yoyotech.co.uk	www.profileit.co.uk	www.ebuyer.com	www.ebuyer.com, www.mobymemory.co.uk
Details	www.adata.com	uk.crucial.com	uk.crucial.com	www.intel.co.uk	www.patriotmemory.com	www.pny-europe.com	www.samsung.com/uk	www.sandisk.co.uk
Part code	ASP610SS3-256GM-C, ASP610SS3-512GM-C, ASP610SS3-1TM-C	CT256MX100SSD1, CT512MX100SSD1	CT256M550SSD1, CT512M550SSD1, CT1024M550SSD1	SSD5C2BP240G4R5, SSD5C2BP480G4R5	PB240GS25SSDR, PB480GS25SSDR	SSD9SC240GCDA-RB, SSD9SC480GCDA-RB	MZ-75E250BW, MZ-75E500BW, MZ-75E1T0BW	SDSSDHII-240G-G25, SDSSDHII-480G-G25, SDSSDHII-960G-G25

## HARD DISKS

			RECOMMENDED			RECOMMENDED	BEST BUY	
	SEAGATE	SEAGATE	SEAGATE	SEAGATE	WESTERN DIGITAL	WESTERN DIGITAL	WESTERN DIGITAL	WESTERN DIGITAL
	Desktop HDD	Desktop SSHD	Laptop SSHD	Laptop Ultrathin	Black	Black <sup>2</sup> Dual Drive	Green	Green Mobile
Rating	★★★★☆	★★★★☆	★★★★☆	★★★★☆	★★★★☆	★★★★☆	★★★★★	★★★★☆
HARDWARE								
Form factor	3½in	3½in	2½in	2½in	3½in	2½in	3½in	2½in
Capacity	2TB/3TB/4TB	1TB/2TB/4TB	1TB	500GB	500GB/1TB/2TB/4TB	1TB + 120GB SSD	500GB/1TB/2TB/3TB/4TB	1.5TB/2TB
Cost per gigabyte	£0.03 (2TB, 3TB, 4TB)	£0.06 (1TB), £0.04 (2TB), £0.03 (4TB)	£0.07 (1TB)	£0.11	£0.10 (500GB), £0.06 (1TB), £0.05 (2TB), £0.04 (4TB)	£0.14	£0.08 (500GB), £0.04 (1TB), £0.03 (2TB, 3TB, 4TB)	£0.07 (1.5TB), £0.05 (2TB)
Interface	SATA3	SATA3	SATA3	SATA3	SATA3	SATA3	SATA3	SATA3
Spindle speed	5,900rpm (4TB), 7,200rpm (other capacities)	5,900rpm (4TB), 7,200rpm (other capacities)	5,400rpm	5,400rpm	7,200rpm	5,400rpm	IntelliPower	IntelliPower
Cache	64MB	64MB/8GB SSD	64MB	16MB	64MB	64MB	64MB	8MB
Quoted seek time	12ms	12ms	8ms	13ms	IntelliSeek	21ms	IntelliSeek	IntelliSeek
BUYING INFORMATION								
Warranty	Two years RTB	Two years RTB	Three years RTB	Two years RTB	Five years RTB	Five years RTB	Two years RTB	Two years RTB
Prices	£63 (2TB), £84 (3TB), £112 (4TB)	£59 (1TB), £84 (2TB), £135 (4TB)	£68 (1TB)	£54 (500GB)	£51 (500GB), £64 (1TB), £102 (2TB), £177 (4TB)	£160 (1TB + 120GB SSD)	£40 (500GB), £43 (1TB), £64 (2TB), £82 (3TB), £118 (4TB)	£102 (1.5TB), £107 (2TB)
Supplier	www.ebuyer.com	www.scan.co.uk	www.scan.co.uk	www.ebuyer.com	www.ebuyer.com	www.ebuyer.com	www.scan.co.uk	cpc.farnell.com, www.scan.co.uk
Details	www.seagate.com	www.seagate.com	www.seagate.com	www.seagate.com	www.wdc.com	www.wdc.com	www.wdc.com	www.wdc.com
Part code	ST2000DM001, ST3000DM001, ST4000DM000	ST1000DX001, ST2000DX001, ST4000DX001	ST1000LM014	ST500LT032	WD5003AZEX, WD1003FZEX, WD2003FZEX, WD4003FZEX	WD1001X06XDTL	WD5000AZRX, WD10EZRX, WD20EZRX, WD30EZRX, WD40EZRX	WD15NPVX, WD20NPVX

Prices correct at time of going to press



# Tame facebook

**Fed up with Facebook? Barry Collins reveals 10 ways to make the social network more bearable and how to set up a social network of your own**

**f**acebook is irritatingly difficult to ignore. It's a site that frequently infuriates users, tramples over their privacy and forces them to use three different apps where one used to work just fine.

Yet it's got you by the unmentionables. It's where your family posts photos you really want to see, where friends arrange nights out, where you go to wish people happy birthday because it's a fraction of the effort required to send them a card. It's where you go to play Scrabble or promote your business. You put up with its foibles because there's no better alternative – and Facebook knows it.

We'll make do no more. In this feature, we're going to show you how to make Facebook a damned sight less annoying.

We'll show you how to regain control of your News Feed, stop the social network spilling your personal details, and how to hide posts from loose acquaintances you don't really like, but feel obliged to follow.

We'll reveal how to use browser plug-ins that let you customise Facebook to your own needs, rather than the site's. You'll find out how to stop people hijacking your account. And we'll explain how you can read updates and message friends from a single app, rather than install the numerous different official apps the company is intent on foisting upon its users.

We're going to make Facebook bearable again. What's not to Like?











# Install Social Fixer



Possibly the best thing to ever happen to Facebook is a browser add-on that fixes many of the social network's most irritating traits. Appropriately called Social Fixer ([socialfixer.com](http://socialfixer.com)), this free plug-in is available for Chrome, Firefox, Safari and Opera, although not Internet Explorer. "Microsoft makes it very difficult to package and distribute extensions for IE, and I don't have access to the right

tools to make them," Social Fix's developer, Matt Kruse, explains on his website.

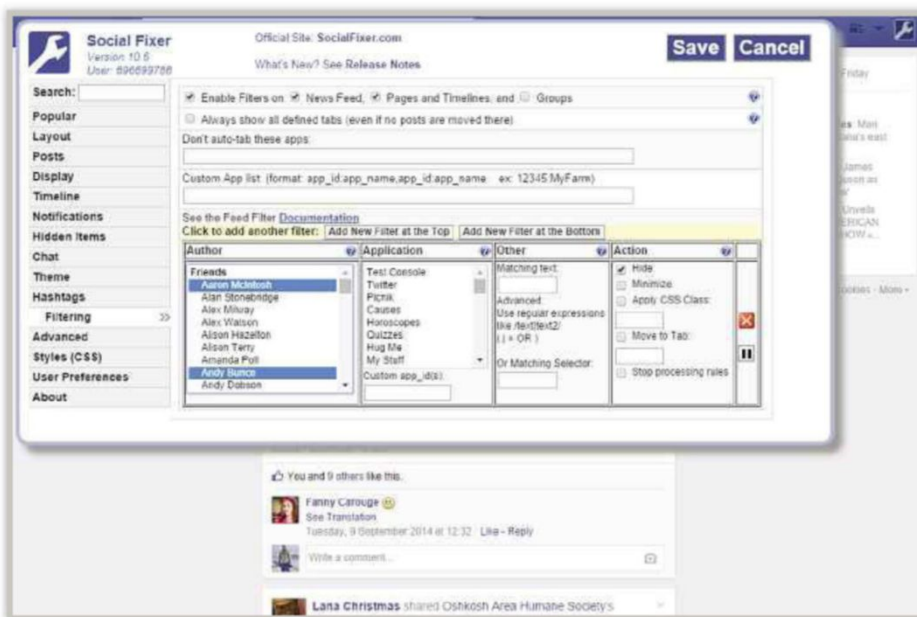
Social Fixer provides an enormous number of customisation options, and we don't have the space to detail all of them, but we'll run through the most useful of them here. When you first install Social Fixer, it runs a setup wizard that gives you the option of accepting the Recommended Settings or opting for the Minimalist Settings. In our opinion, the

Recommended Settings make too many awkward additions to the Facebook interface, and we prefer the Minimalist approach, where you can pick and choose which options to enable. For example, one of Social Fixer's Recommended Settings is to display pop-up, full-size images of any thumbnail you hover over with the mouse, which we find irritating.

However, Social Fixer does most things right. By far its best feature is that it prevents Facebook from constantly reverting your news feed to 'Top Stories' – the ones Facebook judges are of the most interest – instead of 'Most Recent'. Why Facebook insists on this 'mother knows best' approach is bewildering, and we're glad Social Fixer puts an end to such developer arrogance.

Social Fixer also deals with other Facebook frustrations. Pressing Enter when writing a comment will no longer submit the comment, giving you the much needed option to put line spaces in lengthy comments to other people's posts, and submit the comment by pressing Tab and Enter together. The plug-in also ensures that all of your friends who are available for online chat are displayed in the pane to the right of the screen, instead of merely the ones that Facebook randomly decides you might be interested in talking to.

You can toy with any of Social Fixer's myriad options by clicking on the little blue spanner icon that it installs in the top menu bar on your Facebook homepage. Here, among other settings, you'll find options to



⬆ Mute annoying 'friends' without unfollowing them with Social Fixer's filters



# Control your friends

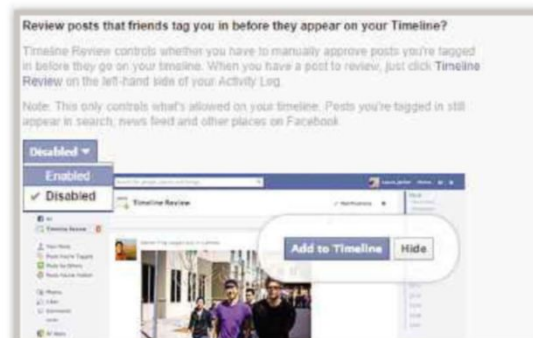


Often, it's not what you put on Facebook that lands you in trouble, but what 'friends' post on your behalf. Being tagged in a photo at Ascot when you were meant to be off work with food poisoning, for example, or a cringeworthy snap of you after a few drinks. If you don't tweak Facebook's privacy settings, all these embarrassing posts will not only end up on your timeline (the page that appears when people click on your name in Facebook), but will appear in the news feed of all your Facebook friends, and potentially the friends of friends, too. Before the hangover has lifted, your 3am tumble down the stairs has been seen by an audience of hundreds.

All this can be avoided with a few tweaks to the main Facebook settings. Click on the padlock icon in the top-right corner, click

Settings, then choose Timeline and Tagging on the left. Here, you can choose to allow only your posts to appear on your timeline, though that can appear a little defensive. A better way to protect your public image is to switch on the option to review friends' posts before they're published on your timeline. You'll get a notification when someone attempts to post something and will be asked to vet the content in the Timeline Review section, which appears in the top left of your Facebook homepage.

If you don't want to censor every post you're tagged in, an even easier way to prevent embarrassing items popping up on your timeline is to select Only You from the drop-down menus asking 'Who can see posts you've been tagged in on your timeline?' and 'Who can see what others post on your timeline?'. This will mean, however, that your



⬆ Tweak settings to prevent friends from putting embarrassing photos on your timeline

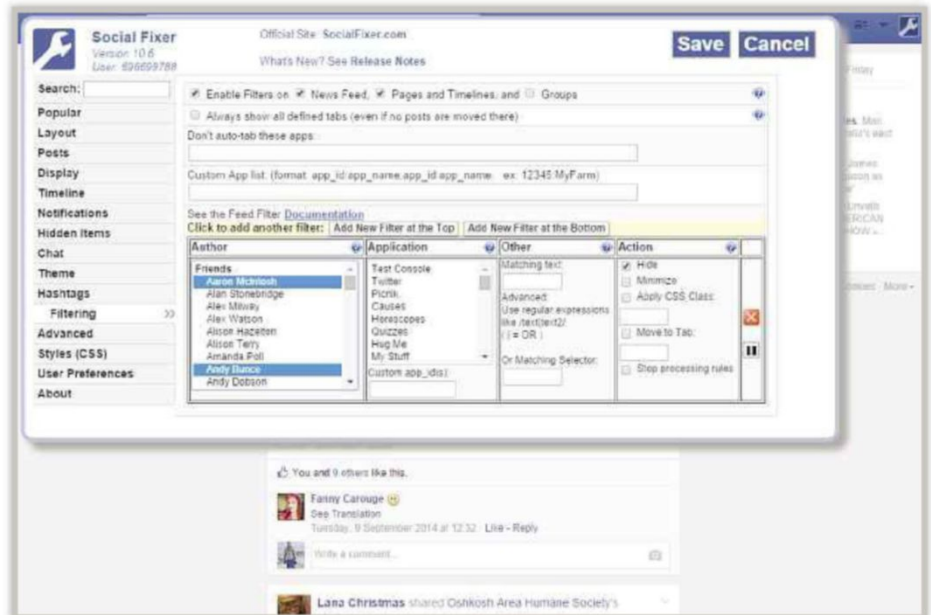
friends will also be barred from seeing perfectly harmless content posted by others.

To prevent friends seeing photos or videos of you disgracing yourself in their news feeds, select Only Me from the list of options for: "When you're tagged in a post, who do you want to add to the audience if they aren't already in it?" However, if your friends are also friends with the person who shared the photo, or friends with anyone tagged in it, there's still a chance they will see the offending image.

change the font size of posts and comments, hide that annoying Facebook pop-up that continually asks you to update your email address, and automatically force chat to log out every time you refresh the page if you're one of the many people who don't want to use Facebook for instant messaging.

Another Social Fixer godsend is the option to filter posts from certain people. This means you can mute those desperately dull folk who post 76 mundane photos of their kids every week, and accept friend requests from people who you don't really like, but feel duty-bound to accept, without having to put up with their drivel on your news feed. To do this, click on the Social Fixer spanner icon and select the Filtering tab from the left-hand side. Then select the person you wish to mute from the Author box (you can select more than one by pressing Ctrl on your keyboard while you left-click their names) and click Hide in the Action box to the far right. Then click the big Save button at the top of the window and refresh the page for your filter to take effect.

Those filters can be used for much more than weeding out the bores on your Friends list. If you scroll to the bottom of the Author list, you'll find a list of the pages you follow, too – a handy option for those pages that demand you follow them to be entered into prize competitions, and then proceed to spam your news feed with offers eight times a day. The filter can also weed out marketing posts from applications your friends use, so you



Need to take a screengrab from Facebook? Social Fixer will anonymise your friends

don't have to put up with constant updates from Candy Crush Saga or other such gubbins.

If you're not a sports buff and your Facebook page is constantly filled with people discussing football, you can even filter the feed based on certain words, such as 'football', 'Man Utd' or 'World Cup'. Those text filters can be applied to individual friends, if you wish, so if one of your valued friends is constantly banging on about a topic that you couldn't care less about, select them from the Author list and enter the banned keywords under Matching Text in the Other section.

Social Fixer also allows you to treat Facebook posts like email, marking them as 'read' once you've scanned the page, so you don't have to reread them again on your next

visit. To do this, you simply click the little tick icon at the top of each post (which will only appear if you've gone for Social Fixer's Recommended Settings) or, more conveniently, go to the Layout tab in Social Fixer's options and make sure the Control Panel is switched on. This will give you a Mark All As Read button at the top of your news feed that hides everything on the page.

One final, small feature that we love about Social Fixer is the option to anonymise the page. This feature changes the names of all your friends on the page, allowing you to take a screengrab without compromising the privacy of any of your friends or revealing that you follow a certain person. Some of the names are highly amusing, too.

## Block app invites and ads



If you're not running Social Fixer (perhaps because you're forced to use Internet Explorer on work computers or because you're accessing Facebook from a mobile device) but would still like to be spared from the endless, automated invites to join friends playing Farmville 2, Pet Rescue Drama or any such timewasting drivel, you can still do something about it.

Go into Facebook's settings and click on Blocking in the left-hand panel. Annoyingly, there's no option to put a blanket ban on app invites – presumably they make too much money for Facebook – but you can block invites from certain individuals or from named apps. We've all got one friend who sends you a fresh invite every eight seconds, so these two settings may at least deal with the most egregious offenders.

Facebook ads are another common irritation, although arguably the price you must pay for accessing a free service. Facebook again lets you block individual advertisers, but not ads outright. To put the kibosh on a selected advertiser, click the faint grey arrow in the top right-hand corner of their ads, and select Hide All Adverts From [advertiser's name]. (Ignore the I Don't Want To See This option, by the way, which just hides the ad for that session.)



Adblock Plus is the most effective way of taming Facebook ads

However, that's a pretty labour-intensive way of blocking ads. A more effective way of wiping them all out is to install the free Adblock Plus ([adblockplus.org](http://adblockplus.org)), which is available for all the major browsers. This removes all third-party advertising from your timeline, including sponsored posts in both your news feed and the column to its right.

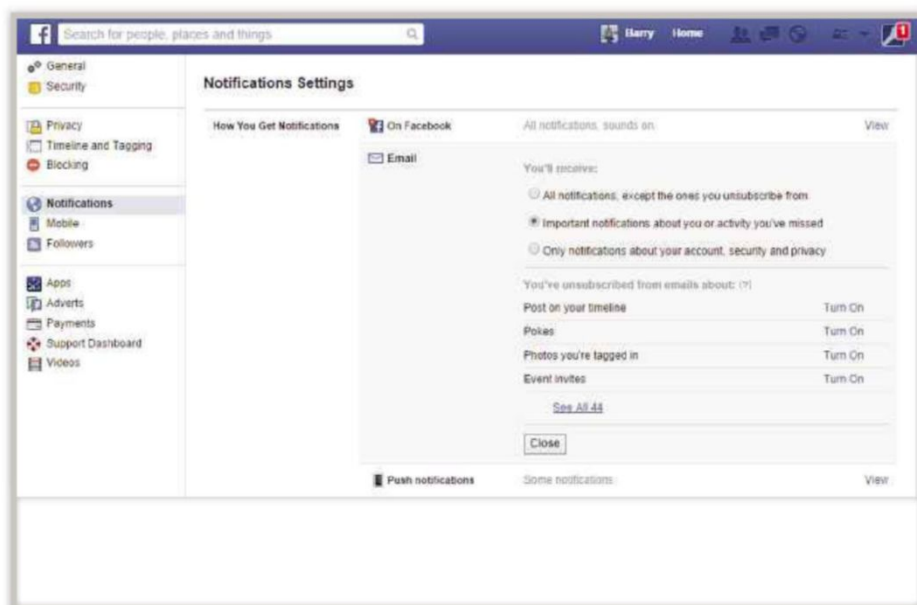


## 4 Stop the spam



The volume of junk mail we have to wade through these days is bad enough, without Facebook adding to the pile. Gmail spotted this problem a while back, and now filters any messages from Facebook into a separate tab, keeping it away from more important messages; Outlook takes a similar approach.

However, it's better to stop the problem at source. In Facebook's settings, click on the Notifications option on the left. In the Email drop-down, you can choose to receive all notifications, important messages, or only notifications that affect your account, security and privacy. Important notifications gets the balance pretty much right, alerting you to new friend requests and when other people mention you in their posts, but to Facebook's credit, you can tweak each type of notification individually so you can customise the 'important' bracket to your precise needs. Switching on email reminders of upcoming birthdays can be pretty handy, for example.



↑ Use email settings to stop Facebook notifications cluttering your inbox

## Create your own social network

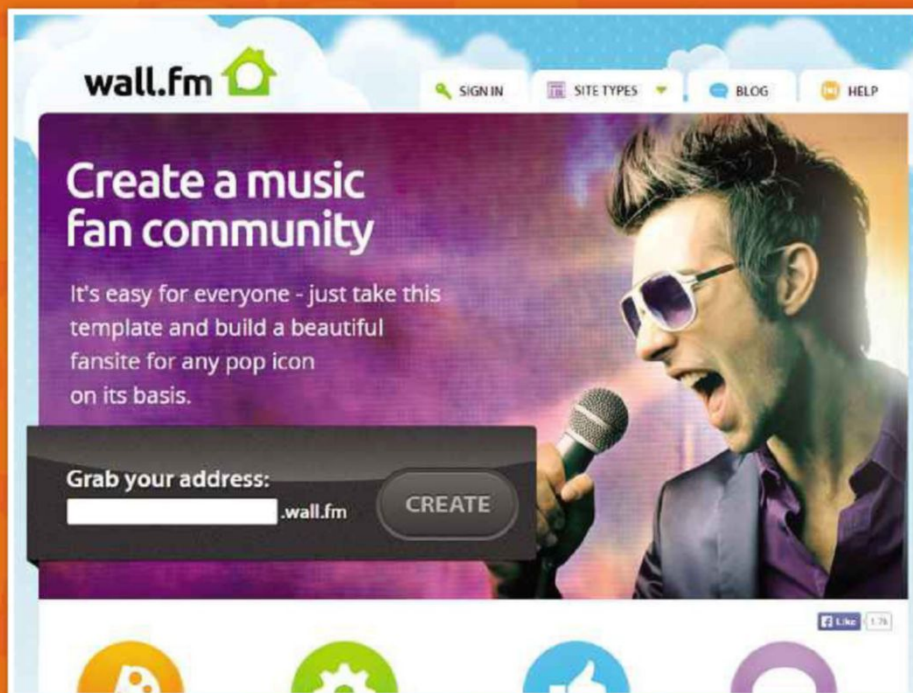
If you've truly had it up to the back teeth with Facebook, and you can persuade your friends and colleagues to come with you, there are alternative social networks that you can set up and manage yourself.

Perhaps the easiest way to do this is with Wall.fm ([wall.fm](http://wall.fm)). This allows you to create a variety of community sites that support features such as events, photo galleries, forums and news feeds. You can tailor your

social network's design using drag-and-drop templates, and you get your own subdomain (in other words, [mygroupname.wall.fm](http://mygroupname.wall.fm)). There is a cost – the most basic option costs \$19.99 per month, but you'll probably need the mid-range Pro package for \$39.99 a month if you have any more than a handful of members. However, split those costs between the group, and it won't be a terribly expensive outlay.

A cheaper alternative is to do it yourself. Wall.fm is powered by a piece of open-source software called Oxwall, which you can host from your own PC (although this isn't really ideal as the PC will need to be on all the time), or preferably via your own website-hosting space. If your web host uses the popular cPanel, you'll find an easy Oxwall installer in the social-networking section of Softalicious. You can see a demo of what an Oxwall social network looks like at [demo.oxwall.org](http://demo.oxwall.org). You should also check out the Admin demo at the top of that site, to get a feel for what it's like to manage an Oxwall social network.

An alternative to Oxwall is Dolphin ([www.boonex.com/dolphin](http://www.boonex.com/dolphin)), which you can also install via Softalicious in cPanel. It has a better feature set than Oxwall, although the Dolphin-based sites we've seen don't look quite as attractive as those built in Oxwall. You can see an online demo at [demo.boonex.com](http://demo.boonex.com).



↑ Wall.fm lets you beat Facebook at its own game – for a price



## Stop apps harvesting all your personal data



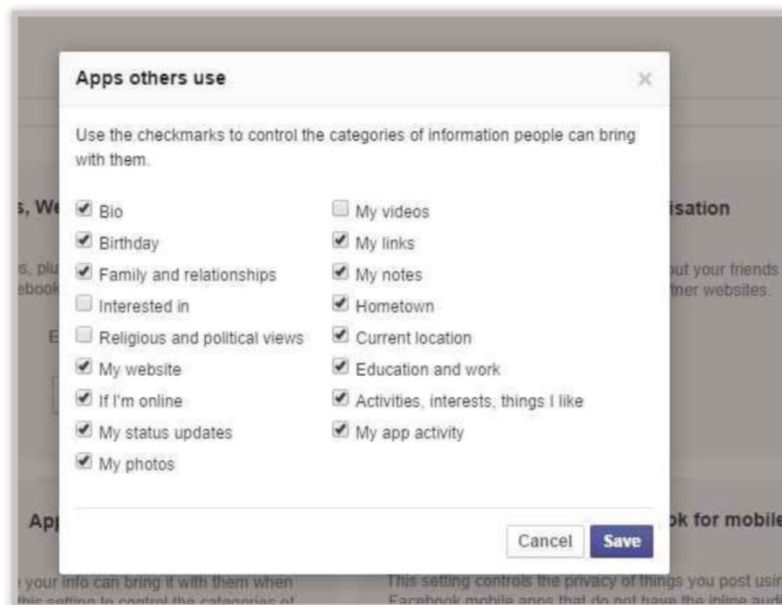
It's only when you start digging through some of the more obscure privacy settings that you truly realise how much information Facebook is willing to give up about you to anyone who wants it. Apps, for example, are allowed to Hoover up all manner of data from your profile – why does a game need to know your activities and interests, or religious beliefs? Presumably so it can use all that data for targeted advertising.

Facebook warns you which data apps will collect when you install them, giving you the option to bail out if you don't like what you see. However, it's not only the Facebook apps that you install that can get all this data, but also apps that your friends are using. You might never have installed a Facebook app in your life, but if anyone on your list of contacts is a devoted fan of Candy Crush Saga or some such, then they might well be inadvertently handing over your personal details on your behalf.

Facebook's excuse for this free exchange of personal data is that certain apps won't function without detailed info on people's friends. "Some apps and games need other people's location information from status updates in order to work. For example, a map that displays your friends' favourite activities in San Francisco will need to know where your friends have been," the site's help pages explain.

To put a stop to this, go to Facebook's settings, click Apps, scroll down to the setting marked Apps Others Use, click Edit and untick anything you'd be unhappy about sharing publicly. This won't claw back any data that Facebook has already shared about you, but it will at least prevent any more app developers from getting their hands on it.

If you really want to avoid all risk of your personal data being passed to app developers, then you need to opt out of the 'Facebook Platform'.



↑ Tame the amount of data Facebook apps can share about you

This will mean you can no longer log in to other websites with your Facebook credentials or use third-party apps. If that doesn't bother you in the slightest, find the Apps, Websites and Plugins section of the page you were just on, click Edit and then Disable Platform.

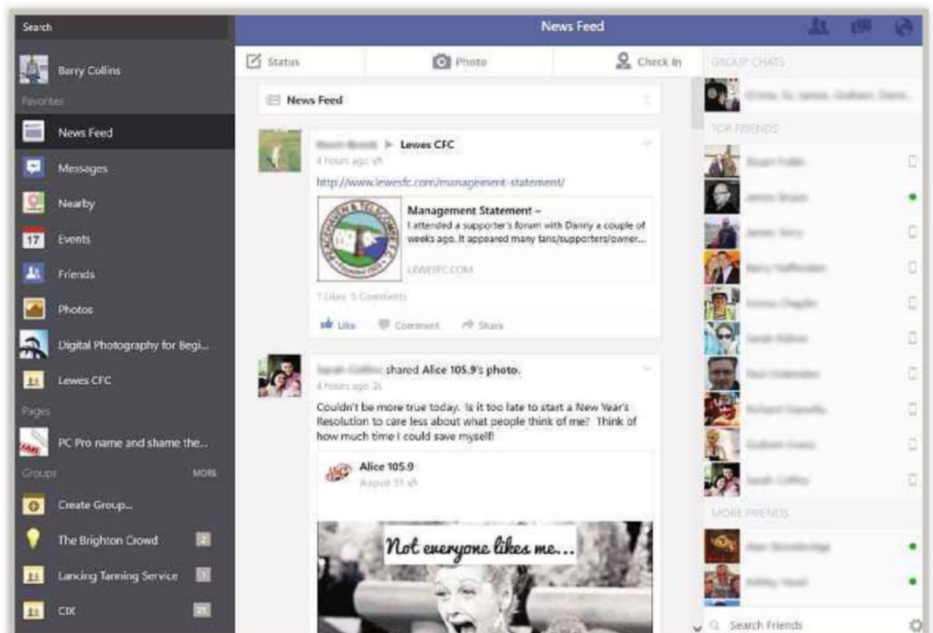


## Install the Windows 8 app



If you're running Windows 8, make sure to download the free Facebook app, because it's a big improvement on the website. It doesn't screw around with the news feed, permanently leaving posts in chronological order; there are no ads whatsoever (at the time of writing); and it's much more neatly presented and well spaced, particularly on smaller laptop screens, where the Facebook website's fonts can sometimes induce eye strain.

Pin the app to your Start screen and you'll also be able to see live tile updates, as well as notifications, so you don't even need to open the app to get the latest updates from your friends and family.



↑ The Windows 8 app is much better than the Facebook website itself

The Windows 8 Facebook app is much more neatly presented and well spaced



## 7 Stop autoplaying videos



Most of Facebook's foibles are tiresome, but don't actually cost you money. However, according to a report on the [Moneysavingexpert.com](#) website, Facebook's recent decision to make videos play automatically has resulted in many smartphone owners suddenly hitting the data cap on their mobile plans, forcing them to either switch off mobile data for the

click the video to get the sound on your phone, it goes back to the start of the clip. It's less fuss all round just to switch them off.

On iPhones and iPads you have to do this in the main device's settings, not from within the Facebook app itself. Open Settings, scroll down until you find the Facebook listing, then click Settings, Auto-play and turn the slider off. On Android devices, open the Facebook

Facebook's decision to make videos play automatically has resulted in many smartphone owners hitting their data cap

rest of the month or cough up for expensive data bolt-ons. Not least because, for a solid month, everyone's Facebook timeline was filled with people taking videos of themselves doing the Ice Bucket Challenge.

Video autoplays are largely pointless, as most videos rely on sound and Facebook doesn't turn that on by default, and when you

app, click the three vertical bars icon in the top right corner, choose App Settings and switch Video Auto-play to off, or Wi-Fi only if you like them but don't want to smash your data cap. To switch the videos off in the desktop browser, open Facebook settings, select Videos from the left-hand panel and choose Off from the drop-down menu.



↑ No more wasted data on autoplaying videos in the mobile app

## 8 Prevent your account from being hijacked



Having your Facebook account details stolen can be deeply unpleasant. At best, a few of your friends are going to get some spam messages in their news feeds, potentially leading to them installing malware on their computers. At worst, the account hackers are going to use your personal information for identity theft, which can have all manner of nasty consequences.

You should take a few basic precautions to guard against Facebook account theft. Make sure you don't reuse your Facebook password on other sites, or else you run the risk of an attack on another, less secure site compromising your Facebook account. As the social network holds so much valuable personal information, it's one of the first sites hackers will attempt to break into when they get a list of usernames and passwords.

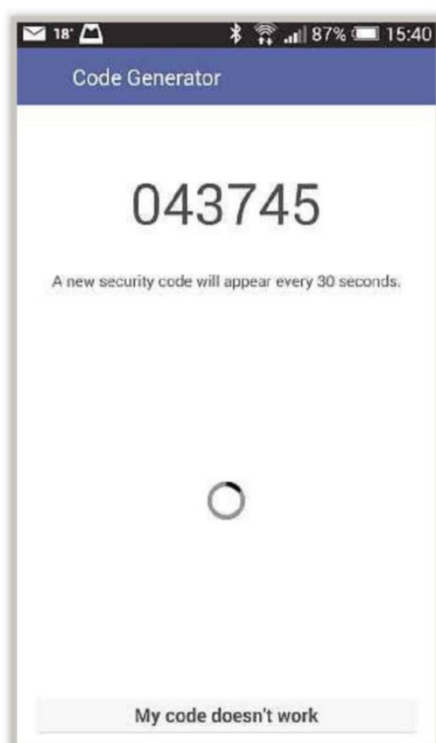
Be particularly careful if you log into Facebook from a public or shared computer. Be careful not to blithely let the browser save your login details, and make sure you log out of Facebook at the end of the session; don't just shut the browser tab or window.

Facebook's two-factor authentication is the best guard against password theft. This means you have to enter a code sent to your

mobile phone every time you log in to Facebook from a new browser, preventing someone who's got hold of your login details from accessing your account – unless they've also managed to steal your smartphone. You'll only need to enter a verification code once for each new browser, not every time you log in.

There are a variety of ways to get these security codes on your phone. Facebook can send them via SMS text message to your mobile phone, although that can sometimes involve a short wait for the message to arrive. Alternatively, the Facebook mobile app has a code generator, which produces a new code every 30 seconds, allowing you to log in instantly. You can also use a third-party code generator, which you may already have installed on your smartphone for logging into other services, such as Gmail.

To set up these mobile security codes, go to Facebook settings and click on the Security link on the left-hand side, then look for the Code Generator section and follow the onscreen instructions. Although you may understandably be reluctant to hand your mobile number to Facebook, we've been using the mobile security codes for months and Facebook has never abused the system to send marketing messages.



↑ The Facebook mobile app can generate its own security codes

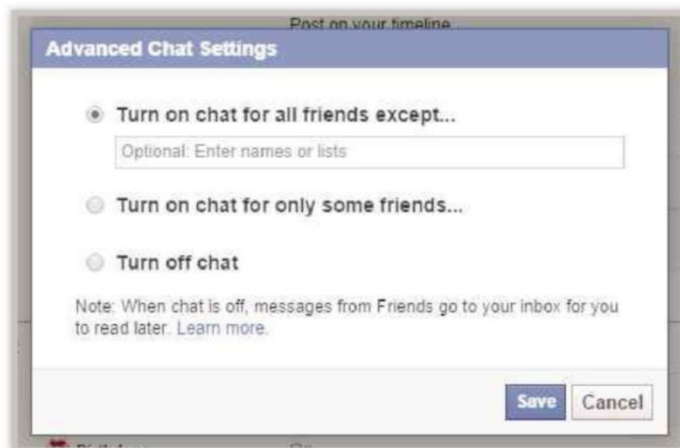
## 9 Stop mindless chat



One of the most annoying facets of Facebook is its online chat facility. You pop on to the site for five minutes at lunchtime, and just as you're about to leave someone you haven't spoken to in real life for 15 years decides now's the time to strike up a real-time conversation that demands an instant answer.

The problem with Facebook chat is that, by default, it makes no distinction between Keith, who you've not seen since sixth form, and your spouse, who you might (and we stress might) actually want to talk to. You have to make this distinction yourself in the site's settings.

In the bottom right-hand corner of the Facebook homepage, click on the little cog in the chat window, then choose Advanced Settings. Here you're given three options. First, you can turn on chat for all friends except a named few, effectively creating a blacklist of folk such



↑ The advanced chat settings allow you to let only certain friends reach you

as Keith. Second, you can switch chat off for all but a named list of friends, creating a whitelist of people you're happy to talk to. Or you can switch the whole thing off altogether and live in peace.



↑ No need for two separate Facebook apps with Friendly for Facebook

## 10



## Combine Messenger and Facebook feeds

Sometimes we wonder if Facebook is just trolling its users, seeing how much grief they will put up with before they finally buckle and move to Google+. Certainly that would explain the decision to remove Facebook chat from the main application, where it worked perfectly well beforehand, and make people install an entirely separate Messenger app to send messages. The same applies for those who manage Facebook Pages, meaning you now need three Facebook apps on your device instead of one.

Thankfully, there's a way to get it all back under one roof, albeit at a small cost. The Friendly for Facebook app on iOS contains all the major features, including your timeline, chat and the ability to manage pages. The free version puts distracting banner ads at the top of the page, but you can pay £2.29 for the premium version, which strips them out.

Unfortunately, we couldn't find anything quite as all-encompassing for Android. Friendcaster is good, but also requires you to install a separate app for chat, while Fast for Facebook includes chat, but doesn't store previous conversations, which is irritating.

## If all else fails...

If Facebook is still driving you up the wall, maybe it's simply time to quit. Before you deactivate your account, though, you can download a copy of all the data you've ever submitted to the site. That includes posts, photos, videos, messages and chat conversations, plus all your personal information from your profile.

Click on the arrow in the top right corner, select Settings, then the 'Download a copy of your Facebook data' link at the bottom. It will tell you that it will take some time to collate all the information into a Zip file for download, and you'll be emailed when it's ready. It only took a couple of minutes for us, and the link is then valid only for a few days for security reasons.

Once you've downloaded your data, head back to Settings and click on Security on the left-hand menu. Select Deactivate your account. Facebook will then try to emotionally blackmail you out of leaving by showing pictures of your friends, saying that they will miss you and providing links to message them.

If you manage to get past that, then you have to provide a reason for leaving –and yes, Facebook has a response for every one of them to try to dissuade you. Then there's a rather confusing box saying that your friends will still be able to tag you in photos or ask you to



↑ Before you leave, you might want to download all your data from Facebook

join groups and Facebook will email you to inform you of this. Tick this if you're serious about stopping using Facebook.

Then Facebook gives you an auto reactivate option, so you can take a holiday from the site without cancelling. Finally you have to hit Confirm, enter your password and hit Deactivate. Despite all that, the account is still there on Facebook's servers and you can reactivate it by simply logging in using your email and password.

If you really want your account deleted from Facebook permanently, then head to [www.facebook.com/help/delete\\_account](http://www.facebook.com/help/delete_account) and fill out the far simpler form there. You get 14 days to change your mind, but after that all your account data is gone forever. ☑



LOVE



AMAZON

# HATE



## THE FIRM WE **HATE** TO LOVE

Amazon claims it's the customer's best friend, but does spotless service mask a multitude of other sins? **Barry Collins** reveals Amazon's darker secrets →



**a**t every Amazon board meeting, one chair is left empty for “the most important person in the room”. It’s not reserved for the company’s ever-enthused CEO Jeff Bezos, or one of his fellow directors. In fact, the seat is saved for a person who never turns up: you.

The empty chair is reputedly a Bezos edict, designed to remind managers that – above all else – the customer comes first. Which perhaps goes to explain why Amazon is almost universally adored by its customers. A recent survey by consumer watchdog Which? placed Amazon ninth in a list of 100 companies offering the best customer service, higher than any other purely online retailer. The year before last (2013) it delivered 99.99 per cent of the packages it promised to get to customers before Christmas. “We’re not satisfied until it’s 100 per cent,” responded Bezos.

Yet it’s perhaps no exaggeration to say its customers are the only people who love Amazon. It’s certainly not widely admired by its competitors, who accuse the company of trying to drive them out of business with its cut-throat pricing. It’s reviled by politicians and campaigners, who accuse the company of shamelessly exploiting every tax loophole it can find to avoid paying its ‘fair share’ of tax.

It’s not much loved by its suppliers – be it international book publishers such as Hachette, who saw its bestsellers withdrawn from sale for refusing to bow to Amazon’s demands, or small traders, who were contractually forced to offer Amazon the best deal on everything they sold.

The company’s not even held in particularly high regard by its own staff. And not just the Christmas temps who are forced to work long hours filling cardboard boxes in soulless warehouses, but company executives who gawp jealously at Google’s gourmet dining and pool tables from their desks made of recycled doors.

Yet perhaps the biggest reason to fear Amazon is its ruthless ambition. It wants a slice of anything and everything: music, groceries, smartphones, holidays, garden furniture, server space, clothing, dog food, a canvas clock bearing the face of *EastEnders’* Phil Mitchell – you name it, Amazon sells it, or plans to do so in the future. That relentless expansion is why a company that’s been going 20 years and turns over \$20 billion of revenue

## Perhaps the biggest reason to fear Amazon is its ruthless ambition. It wants a slice of anything and everything

every quarter rarely makes a profit. In fact, in the three months up to October 2014 it lost almost half a billion dollars.

Does anyone really care, as long as Amazon delivers your DVDs when you want them? Perhaps it’s time to take a harder look at the company that drops delights through our letterboxes.

### Cut-throat pricing

One of the reasons Amazon is the first port of call for internet shoppers is that it’s almost impossible to beat on price. The company has invested heavily in price-tracking technology that spiders the sites of major rivals to ensure that Amazon is never significantly undercut.

Anybody who’s ever sold anything via Amazon will have seen this in action. On Kindle self-published books, for example, the author sets the price, getting a fixed percentage from Amazon for every sale made. However, if Amazon’s software spots that book being offered for less in a rival eBook

store, it will automatically lower the price, sacrificing its own cut of the profits to make sure that the customer chooses Amazon above all others. It’s one of the reasons Amazon has a 79 per cent share of the UK eBook market, according to Ofcom’s digital consumption study, which gives it a monopoly in the eyes of the Monopolies and Mergers Commission.

It’s not only eBooks on which Amazon is willing to sacrifice its margins. Practically everything in its store is subject to continual fluctuations in price as Amazon’s automated system reacts to the slightest movement from competitors. Over the course of a month, the price of an Xbox 360 with FIFA 15 bundle flitted between £189 and £189.95 six times, presumably just so Amazon came in cheapest on Google Shopping and other price comparison sites.

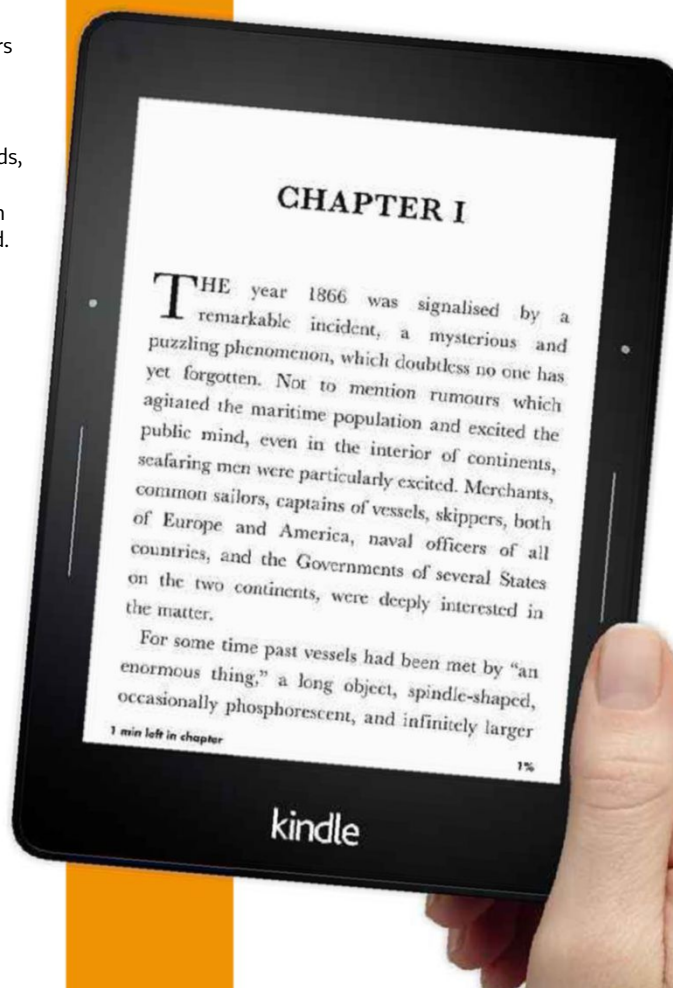
The camelcamelcamel (uk.camelcamelcamel.com) website is geared exclusively to track prices across Amazon, sending alerts to users when a product they have their eye on hits a new low. In 2012, the site studied price fluctuations across the 10,000 most tracked products by users of its website. “On a weekly basis, price changes were registered for almost 40 per cent of products at the beginning of the year and up to 54 per cent at the peak of the Black Friday madness in November,” the site reported on its blog. “So more than half of the most popular products on Camel changed their price during one week in November!” The site noted how the price of one ice-cream maker fluctuated between \$50.39 and \$80.31 over the course of three years, with its price changing almost every day.

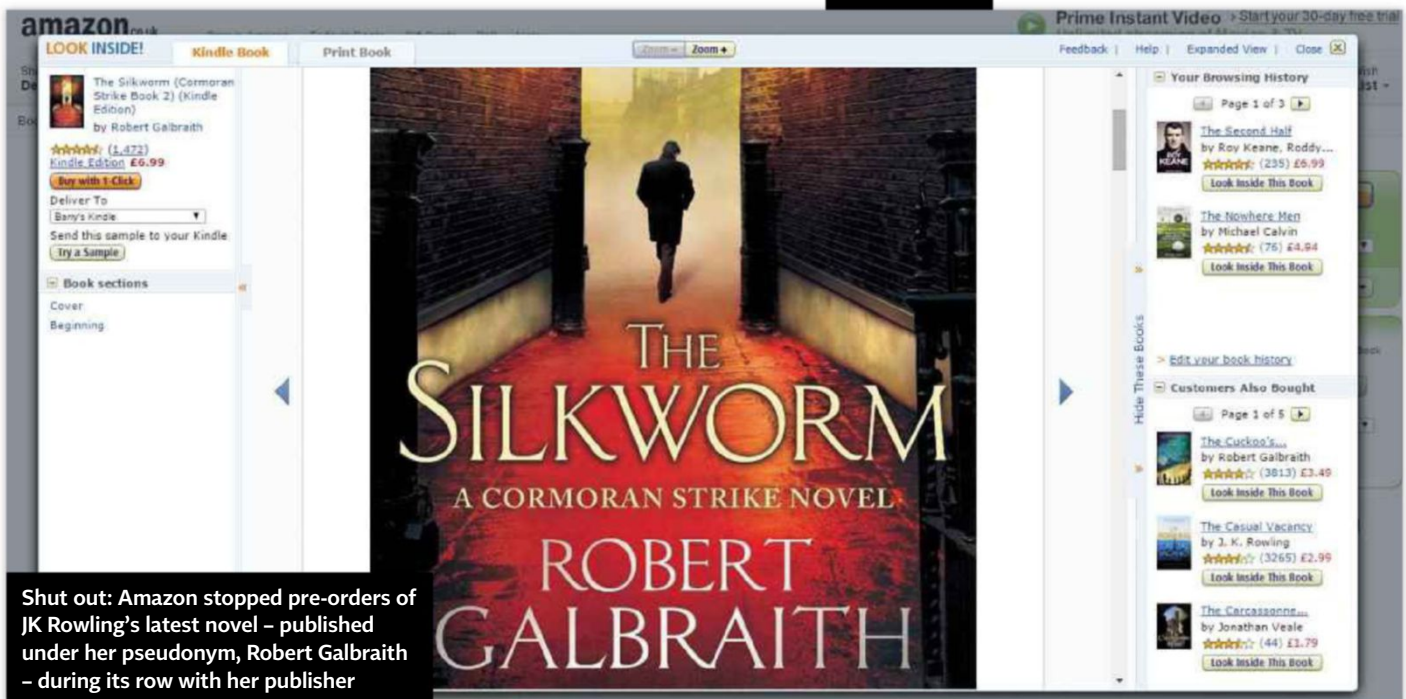
All’s fair in love and price wars, you might argue. But Amazon has two distinct advantages over many of its rival retailers. First, it pays almost no regard to profit margins,

willingly sacrificing a return to shareholders to continue bulldozing its way into different markets.

Second, it pays almost no tax even when it does make a profit.

↓ Firm grip:  
Amazon  
controls the  
eBook market





✦ **Taxing questions:** Amazon executives have been grilled on tax avoidance by MPs

Amazon UK turned over £4.3 billion worth of sales in 2013, yet Amazon UK declared a turnover of only £449 million. How? Because Amazon's European base (along with that of many other tech companies) is registered in Luxembourg, with the UK company registered purely to provide services such as warehousing and accounting to the mothership.

Consequently, Amazon contributed only £4.2 million in corporation tax in 2013, while rival John Lewis contributed £47.1 million on a turnover of £8.7 billion – ten times more tax for twice the turnover. Little wonder Amazon can afford to undercut its rivals, argue MPs. “They are damaging British jobs,” said chair of the Public Accounts Committee, Margaret Hodge, who has hauled Amazon executives over the coals in parliament. “If you are a small bookshop in the high street you can

never compete with their prices, because you pay taxes. Even for John Lewis their future is also threatened because they pay their taxes.”

That, of course, disregards the vast amounts of VAT and other economic benefits Amazon returns to the UK by employing thousands of people in the country. And, as Amazon has long insisted, it “pays all applicable taxes in every jurisdiction that it operates within”. That statement puts the ball firmly back in the court of European lawmakers, who are now finally coming around to quashing such labyrinthine tax arrangements, with Luxembourg bearing the brunt of public scorn.

### Cancelling out competition

Amazon doesn't only drive down prices of its own stock, it hammers down the margins on other people's products, too. Four in ten sales and a fifth of

Amazon's revenue is generated from third parties selling through Amazon's website, the sellers paying fees for being listed on the site.

Until recently, a clause in the Amazon Marketplace contract stipulated that these third-party sellers could not offer better prices for their goods on other websites – including their own! So, when Amazon hiked up the fees for selling goods such as electrical accessories from 7 per cent to 12 per cent in April 2013, many sellers were left with Hobson's Choice: suck up the damage to their profit margins or leave the most recognised internet seller in the UK.

“I love Amazon and I hate Amazon,” one of the affected third-party sellers told *The Guardian*, speaking anonymously through fear of being shut down if caught publicly criticising the company. “They're a necessary evil. I buy from Amazon. You probably do as well. I just don't like the way we're being treated. They are certainly not ‘the box with the smile on’ they make themselves out to be.”

That particular practice came to an end last summer, however, when an Office of Fair Trading (OFT) investigation was halted after Amazon agreed to remove the clause demanding price parity with other sites. “We are pleased that sellers are now completely free to set their prices as they wish, as this encourages price competition and ensures consumers can get the best possible deals,” said Cavendish Elithorn, senior director of the OFT's goods and consumer group. Amazon continues to impose the clause on sellers in other countries.





## Comply or die

It's not only small retailers Amazon plays hardball with. Amazon spent the best part of last year embroiled in a public spat with the international publisher, Hachette, after the French company refused to hand over control of eBook pricing to Amazon.

In Amazon's defence, it was once again arguing for cheaper prices for the consumer and produced some pretty compelling evidence to back up its assertion that everyone would be better off if Hachette sold its latest eBooks for only \$9.99, and not the \$14.99 upwards at which the company priced its titles.

"It's important to understand that eBooks are highly price-elastic," Amazon argued in a blog post. "This means that when the price goes up, customers buy much less. We've quantified the price elasticity of eBooks from repeated measurements across many titles. For every copy an eBook would sell at \$14.99, it would sell 1.74 copies if priced at \$9.99. So, for example, if customers bought 100,000 copies of a particular e-book at \$14.99, then customers would buy 174,000 copies of that same e-book at \$9.99. Total revenue at \$14.99 would be \$1,499,000. Total revenue at \$9.99 is \$1,738,000."

Amazon's win-win argument had undeniable logic and made it look as if the company was fighting the customer's corner. However, it quickly surrendered the PR battle when it decided to try to bring Hachette to heel. Amazon removed several of Hachette's key titles from its store and removed pre-order options for some of



the publisher's forthcoming releases, including *The Silkworm*, JK Rowling's much-anticipated second novel under her new pen name of Robert Galbraith.

Amazon isn't the first company to rough up a recalcitrant business partner, and it won't be the last, but by preventing customers from buying some of the biggest books of the year, Amazon had also forgotten about the person in the empty chair. It was using the customer to get at a supplier.

John Grisham and Stephen King accused Amazon of "holding writers hostage"

“Amazon isn't the first company to rough up a recalcitrant business partner, and it won't be the last”

Amazon's customers weren't the only ones who were upset that they couldn't click to buy Hachette's titles. The authors were pretty ticked off, too. Within weeks, almost 1,000 authors – including household names such as John Grisham, Salman Rushdie and Stephen King – had signed an open letter calling for Amazon to “stop holding writers hostage” in its negotiations with Hachette.

“It is not right for Amazon to single out a group of authors, who are not involved in the dispute, for selective retaliation,” read the open letter, which was published in the *New York Times*. “Moreover, by inconveniencing and misleading its own customers with unfair pricing and delayed delivery, Amazon is contradicting its own written promise to be ‘Earth's most customer-centric company.’”

Sensing the PR battle had been lost, risking damage to its reputation with the people it claims to care about most, Amazon backed down. Hachette was allowed to continue setting the price of its own eBooks under the terms of a new multi-year contract, albeit with financial incentives to keep those prices as low as possible.

Hachette called Amazon's bluff and won the fight – this time. Though whether that proves to be a boon for consumers is still a rather grey area.

## Cutting out the middlemen

Amazon would probably prefer the publishers didn't exist in the first place. Part of its PR offensive in the dispute with Hachette was a direct plea to authors, implying that the publisher was ripping off its writers.

# TREATING CUSTOMERS BETTER THAN STAFF?

Amazon may be famed for treating its customers well, but it's not exactly renowned for bending over backwards for its staff. Tales of Christmas warehouse temps being forced to do physically demanding work for long hours and little pay are almost an annual staple for the newspapers. But is Amazon's taskmaster reputation a tabloid invention or well deserved?

BBC *Panorama* sent an undercover reporter to work as a picker in Amazon's Swansea warehouse in 2013. The night shifts involved walking up to 11 miles, with workers expected to collect orders every 33 seconds. The reporter was given a handset that told him what to put in his trolley, and counted down the number of seconds he had left to collect the item. Experts told the BBC that the demands of the job – which paid as little as £6.50 per hour – could cause both “mental and physical illness”.

In 2011, an undercover investigation into one of Amazon's warehouses in Pennsylvania found that temperatures inside the building reached as high as 46°C, and that the company had paramedics stationed in the car park to treat employees suffering from heat exhaustion and dehydration. The company spent millions upgrading air conditioning in its warehouses shortly after, although critics questioned whether this was to improve working conditions or merely to stop Amazon's new range of food products from rotting.

Certainly Amazon fares worse than many leading technology companies on Glassdoor ([www.glassdoor.co.uk](http://www.glassdoor.co.uk)), which asks employees to rank their satisfaction with their employer. Amazon



scored 3.4 out of 5 at the time of publication, with work/life balance rated at just 2.7 out of 5. That overall score compares unfavourably to Facebook (4.5), Google (4.4), Apple (3.9) and Microsoft (3.7).

Yet Amazon, with its vast warehouses, is bound to have a far higher proportion of low-skilled, low-paid manual workers than any of those tech giants. When compared to fellow retailers, Amazon's score surpasses most. The US supermarket giant Walmart scores only 2.8, Tesco and Argos both score 3.3, while Asda gets 3.1. That's not to say manual workers deserve to be treated any less well than software developers, but perhaps Amazon isn't quite the monster it's made out to be.

In the same blog post in which Amazon outlined its argument for books to be sold for \$9.99, the company also spelled out how it would split that revenue, arguing “35 per cent should go to the author and 35 per cent to Hachette”. What actually happens, Amazon added, is that it sends 70 per cent of the total revenue to Hachette, and the publisher decides how much should be passed on to the writer. “We believe Hachette is sharing too small a portion with the author today, but ultimately that is not our call,” Amazon added, somewhat mischievously, and omitting to mention that it was allegedly trying to increase its own cut to 50 per cent.

Amazon offers authors the chance to publish their own eBooks via its Kindle Direct Publishing service, which offers writers the chance to keep up to 70 per cent of their sales revenue. But perhaps less well known is Amazon Publishing ([www.apub.com](http://www.apub.com)), the company's own in-house publisher that signs authors across 14 different types of literature, from self-help books and science fiction to comics and graphic novels. “Our team works closely with authors at every stage of the creative process to bring their books to life and help them find their widest potential readership,” says the publisher's About Us page, further explaining how the

➔ **Lock-in:**  
Amazon's phone may run Android, but you can't use Google's Play store

company offers things that “authors might not expect, including monthly royalty payments, access to daily sales reports, and a dedicated Author Relations Manager”.

Amazon may not be able to convince the publishers to cut prices, but it's trying to convince authors to cut out their publishers. A dominant bookseller with a big publishing arm is a combination much like that of the Hollywood studio system – where it controlled everything from actors to cinemas – or the UK's tied house system of pub ownership. Both of those were taken apart by governments, but that may not be possible in today's global business world.

Publishing isn't the only example of Amazon stepping on the toes of its partners. In November 2014, shares in the recently privatised Royal Mail dipped sharply when it warned it was facing increased competition from none other than the company that currently provides a large chunk of its parcel business. “We estimate that the impact of Amazon delivering an increasing number of its own parcels using its own delivery network will reduce the annual rate of growth





in our addressable market to 1-2 per cent,” the Royal Mail cautioned.

Slightly hampering growth might not sound like an enormous cause for concern, but delivery of items is now more important to Amazon than ever before, with the company aggressively pushing its Amazon Prime subscriptions, which promises one-day delivery on millions of items. Amazon has 11 different courier firms working in the UK alone, and the logistics of managing next-day delivery must be terrifying.

If Amazon can take control of the process *itself*, whether that be by delivering directly to customers’ doors or dropping off packages at the growing number of Amazon Locker or collection points across the country (now including Post Offices), you can bet that it will. It’s even investing millions in drones to drop packages at people’s front doors. Amazon doesn’t only want to sell everything it can lay its hands on; it wants to deliver it all to customers, too.

### Total control

It’s not just the delivery of physical products that Amazon wants full control over, but virtual goods, too. Its dominant Kindle eBook system is a closed **monopoly**: only eBooks bought from Amazon can be loaded on to Kindle readers (officially, at least), and only Kindle devices or apps can be used to be read eBooks bought from Amazon.

Amazon is trying desperately hard to replicate that model in other branches of technology, too. The ever-expanding range of Kindle tablets run a bastardised version of Android that forces users to buy from the company’s own app store – access to the generic Google Play Store is barred. The Fire smartphone follows the same blueprint.

Last summer, the company thrust itself into the video-on-demand market with the Amazon Fire TV. It didn’t just produce a set-top box through which you could watch movies or listen to music through the Amazon store; it ramped up its efforts to become a full-blown television studio, too. Amazon Studios now has seven home-produced television series available exclusively to Prime customers, with at least another seven slated to be released some time in 2015. Amazon will grudgingly let you watch

“In confronting what to do about Amazon, first we have to realise our own complicity”

Netflix on your Fire TV or tablet, but it would much rather actually be Netflix.

It’s taking tentative steps into the gaming market, too. The Fire TV has an optional games controller that lets you play titles such as Minecraft or Asphalt 8. Oh, and not forgetting Sev Zero – “a brand-new exclusive from Amazon Game Studios”. Yes, the company has its fingers in that pie, too.

Finally, Amazon doesn’t even follow the accepted rules when it comes to the internet. Go to practically any website and you’ll find links to other websites, but not with Amazon. There are no outbound links on Amazon’s huge sprawling shopping site – not one, anywhere. Amazon’s site is an internet black hole: traffic goes in, but nothing comes out.

◆ The boss: Jeff Bezos owns a fifth of the shares in the company he runs



In short, Amazon is a digital bookseller with its own publishing arm, a set-top box maker with its own television studio, a console manufacturer with its own games studio, and it sells all this content (and much more) through its own app store on a multitude of devices. It’s come a long way from the company that started out selling paperbacks from a lock-up. Has it gone too far?

### Taming the beast

There are some that believe Amazon is already out of control and needs reining in. Franklin Foer, former editor of the respected US magazine *The New Republic*, recently wrote a fierce polemic entitled ‘Amazon Must Be Stopped’, in which he argued the company was a modern monopolist that must be confronted.

Foer argues that Amazon’s spotless customer service has blinded us to the company’s darker side. “In confronting what to do about Amazon, first we have to realise our own complicity,” he says. “We’ve all been seduced by the deep discounts, the monthly automatic diaper delivery, the free Prime movies, the gift wrapping, the free two-day shipping, the ability to buy shoes or books or pinto beans or a toilet all from the same place. But it has gone beyond seduction, *really*. We expect these kinds of conveniences now, as if they were birth rights. They’ve become baked into our ideas about how consumers should be treated.”

“These expectations help fuel our collective denial about Amazon,” he adds. “We seem to believe that the web is far too fluid to fall capture to monopoly. If a site starts to develop the lameness of an AltaVista or Myspace, consumers will *unhesitatingly* abandon it. But while that meritocratic theory might be true enough for a search engine or social media site, Amazon is different.”

He bemoans Amazon’s predatory behaviour towards companies that “begin to pose a competitive challenge”, such as the childcare retailer Diapers.com.

“It uses its riches to undercut opponents on price – Amazon was prepared to lose \$100 million in three months in its quest to harm Diapers.com – then once it has exhausted the resources of its foes, it buys them and walks away even stronger.”

Yet, unlike tech rivals such as Microsoft and Google, Amazon has so far evaded the attention of the competition authorities. There appears to be little or no appetite to curb Amazon's aggressive behaviour.

Perhaps the biggest threat to Bezos's rapacious expansion is Amazon's own shareholders. The company has made no significant profit in its 20-year history. That didn't seem to bother investors unduly until recently, when the company's share price started to plateau for the first time in its history, with the stock (at the time of writing) trading at roughly the same level as it was in autumn 2013.

Have investors finally grown weary of Bezos's 'jam tomorrow' attitude? Are they scared that this sprawling beast of a company will never turn a profit, while rival retailers such as Walmart and even the troubled Tesco bring home billions every year?

"Investors put their money into companies, Amazon and any other, with the expectation that at some point they will get cash out," wrote renowned tech analyst and Andreessen Horowitz partner Benedict Evans recently. "With Amazon, Bezos is deferring that profit-producing, investor-rewarding day almost indefinitely into the future."


➔ Amazon's latest 'Eighth Generation Fulfilment Centres' use these Kiva robots to move shelf stacks around the warehouse, allowing for far greater efficiency and fewer staff



This prompts the suggestion that Amazon is the world's biggest 'lifestyle business' – Bezos is running it for fun, not to deliver economic returns to shareholders, at least not any time soon.

"But while he certainly does seem to be having fun, he is also building a company, with all the cash he can get his hands on, to capture a larger and larger share of the future of commerce," Evans added. "When you buy Amazon stock (the main currency with which Amazon employees are paid, incidentally), you are buying a bet

that he can convert a huge portion of all commerce to flow through the Amazon machine. The question to ask isn't whether Amazon is some profitless ponzi scheme, but whether you believe Bezos can capture the future. That, and how long are you willing to wait?"

Thankfully for Amazon, it seems the company's largest shareholder – who owns around a fifth of the business – isn't running short of patience. His name? Jeffrey Preston Bezos, CEO, president and chairman of the board of Amazon.com. 

## EMPIRE BUILDING

Amazon stocks an enormous range of products. In the UK alone, the company sold 4.1 million items on its busiest day in the run-up to last Christmas, a rate of 47 products ordered every single second. However, as we've discovered throughout this feature, Amazon isn't just a retailer: it's a television studio, a publisher and much more. Here are some of the other businesses that you might not have realised Amazon owns.

### IMDb

The Internet Movie Database ([www.imdb.com](http://www.imdb.com)) is firmly established in the bookmarks of film buffs, providing the latest trailers, news and cinema show times, as well as an unrivalled database of movies and television shows, each with its own viewer rating. Amazon bought the site in 1998, using it as a means to sell DVDs and now video-on-demand.

### Audible.com

Amazon is very wary of any threat to its stranglehold on the book market, which is why it paid \$300 million for the world's largest audiobook company in 2008. Amazon has since integrated the technology into its Kindle devices and apps. Now you can listen to your audiobook on the walk back from work, and pick up where you left off in the eBook when you get in.

### DPRReview.com

Photography enthusiasts will almost certainly have browsed many of the exhaustive camera and lens reviews on Digital Photography Review over the years. Its link to Amazon is barely revealed on the



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**Sounds familiar: Amazon bought audiobook firm Audible in 2008**

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site itself, but Digital Photography Review was bought outright in 2007. Naturally, all options to purchase camera equipment redirect straight to the mothership.

### Alexa

Better known in the US than it is over here, Alexa provides detailed analytics for website owners, showing how visitors arrived at their site, where their traffic is coming from and much more. It measures site popularity by encouraging consumers to install a toolbar that tracks their online behaviour. Amazon bought the site in 1999, giving it access to a vast treasure trove of data about its competitors' websites, among other things. Little-known fact: Alexa is also behind the Wayback Machine ([archive.org/web/](http://archive.org/web/)), which archives past versions of websites for posterity.





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<sup>8</sup>O<sup>2</sup>f

# Chemistry Computing

Did you know that sand forms the basis of all our computers?

**Mike Bedford** looks at how the elements become components in your PC, and asks if current methods are sustainable

If you take more than a passing interest in what makes your PC tick, chances are that the concept of manufacturing processors with billions of transistors, each with unimaginably small dimensions, in an ultra-clean fabrication facility costing millions of dollars will be a familiar one. Other than knowing that silicon is a key ingredient of the chips that power them, though, the materials that are used in manufacturing our PCs remain a mystery to many. Yet silicon is just one of the dozens of chemical elements that come together to bring us everything from smartphones to super-computers. Far more obscure but no less essential are such weird and wonderful substances as hafnium, tantalum, ruthenium and indium. It's not just chemical elements that play their part in PC manufacture, either. Chemical compounds are important too and, to the untrained eye, some of them have astonishingly complicated names and formulae.

Here we delve into some of the strange substances lurking in our PCs and look at the contribution these elements and compounds make. We'll also examine where these substances come from and, in some cases, how they're extracted from their ores and refined to the high degree of purity needed in this most demanding of applications. We will



also reveal why some are hugely expensive while others are so rare as to cause concerns over the ongoing viability of the electronics industry. So if you thought that computer technology was concerned exclusively with electronic engineering, think again, as you join us on a voyage of discovery into the chemistry of computing.

## Silicon and beyond

We really can't start our investigations with anything other than silicon even though, as we're about to see, the phrase 'silicon chip' is a vast oversimplification. Before we get down to business, though, we need to introduce the periodic table that shows each of the chemical elements arranged according to the number of electrons in each element's atoms. This arrangement causes elements with similar properties to appear in the same vertical groups. In particular, the metals, which are good conductors of electricity, appear at the left and are coloured green in the periodic table shown over the page, while the non-metals, which are poor conductors, appear at the right and are coloured orange. Of special interest to the electronics industry are the blue-coloured elements that are in a group known as metalloids.

Silvery in appearance, metalloids look like metals, but unlike most metals, they tend to be brittle. Crucially, they're also intermediate in their electrical conductivity, being poorer conductors than metals but better than non-metals. Silicon is a classic metalloid; while its electrical conductivity is mediocre, it can be improved by a process known as doping, which involves adding a small amount of a different element.

Doping silicon with a Group 15 element, one higher than Silicon's Group 14, results in a so-called n-type semiconductor, which is more conductive than pure silicon because of the presence of surplus electrons. In practice, phosphorous is generally used. Doping with a Group 13 element produces a p-type semiconductor, which has missing electrons (and is able to conduct by the migration of these so-called holes, but we won't go into that here). Boron is the dopant of choice for this purpose. The operation of a transistor, a component that is able to use one electrical signal to turn another circuit on and off, and which is the building block of all electronic circuits, relies on the interaction between n-type and p-type semiconductor materials.

Unlike some of the other elements found in a PC, silicon is one of the most common in the Earth's crust, accounting for almost a third of our



The periodic table shows all the chemical elements in such a way that those with similar properties are grouped together

Continued scaling of a transistor's dimensions had got to the point where the gate insulator was just a few molecules thick. With silicon dioxide an electrical current would have leaked through the insulator, with negative implications for both reliability and power consumption. The solution adopted was to replace the silicon-based insulator with one



↑ Silicon might look like a metal, but its properties are intermediate between a metal and a non-metal

that had a higher dielectric constant, or high-k. Hafnium is the element that fitted the bill in the form of its oxide, hafnium dioxide. By using this material, the insulating barrier can be made **thicker**, so leakage was reduced, while maintaining the capacitance needed to turn on the transistor.

## Get it together

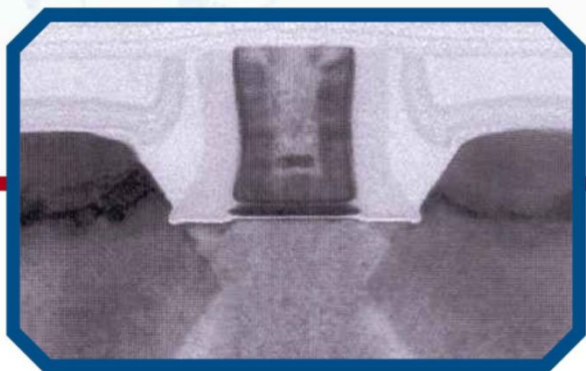
The materials we've seen so far are used in a hugely complicated multistage process to create a chip

containing the billions of transistors that are needed to perform the computational miracle of today's processors. In order for those countless transistors to become a working circuit, however, they need to be connected together in the correct **order**, something that is achieved using several layers of interconnects, each one insulated from the underlying transistors and from each **other**.

Some years ago these conductive pathways were made from aluminium but **now**, in order to reduce their resistivity and thereby also reduce the chip's power consumption, copper is used instead. It's the second most conductive element, with only silver being slightly more conductive; better still, copper is neither rare nor expensive.

Copper has a myriad of uses; for example, it's also used for connecting together the components in a PC's motherboard. However, this usage pales into insignificance compared to the amounts used in overhead power cables. Such industrial usage means that copper is the third most produced metal on the planet, with an annual production of 18 million tonnes. No wonder, then, that opencast copper mines such as Chile's 645m deep and 3.9km long Escondida mine in the Atacama Desert are some of the largest man-made holes in the ground.





↑ There are only tiny amounts of hafnium in our processors, but they wouldn't work reliably without it

Copper alone doesn't complete the story of connecting the transistors in a microprocessor because, if it was in direct contact with silicon dioxide, atoms from the copper would migrate into the silicon oxide, thereby making it conduct. To prevent this, a liner is required to block this transfer of copper. Various materials have been used for this purpose, but today, tantalum nitride is one of the most common.

Tantalum accounts for just two parts per million of the earth's crust, making it pretty rare. What's more, one of the major suppliers of the metal is the war-torn Democratic Republic of the Congo (see the box on the right). While we'll come across much rarer elements when we look at how hard disks are made, tantalum is used in much larger quantities than these ultra-rare metals, particularly in the capacitors that play an important role in the operation of PC motherboards. Add all that up, and you can see why there are concerns about tantalum's long-term availability.

## Elements in a spin

If a so-called silicon chip is, in reality, a mixture of elements, a hard disk is an even more exotic conglomeration of chemical elements, some of them extremely rare and expensive. This article is concerned with chemistry, so we're not going to look at the manufacturing process in much detail, but it still makes sense to investigate the substances in the order in which they're used.

Although the data on a hard disk's platter is stored in a comparatively small amount of magnetic material, adequate strength can only be achieved by depositing those materials on to a reasonably thick substrate. That substrate needs to be light so that it can easily be spun at several thousand revolutions per minute; it must not have magnetic properties in itself;

and it must be cheap. Given that there will be a clearance of just a few nanometres between the platter and the read/write head, the platter must also be rigid, flat and extremely smooth. These requirements are met by making the so-called blank from an aluminium alloy that also contains other lightweight metals, most commonly magnesium and zinc.

Despite the excellent properties of the aluminium alloy, though, as it stands the blank cannot be polished to an accurate enough surface. Another chemical referred to as NIP, which is an alloy of nickel and phosphorous, is sufficiently hard that, when deposited on the aluminium blank, it can be polished to the necessary smoothness of 0.1nm, or about

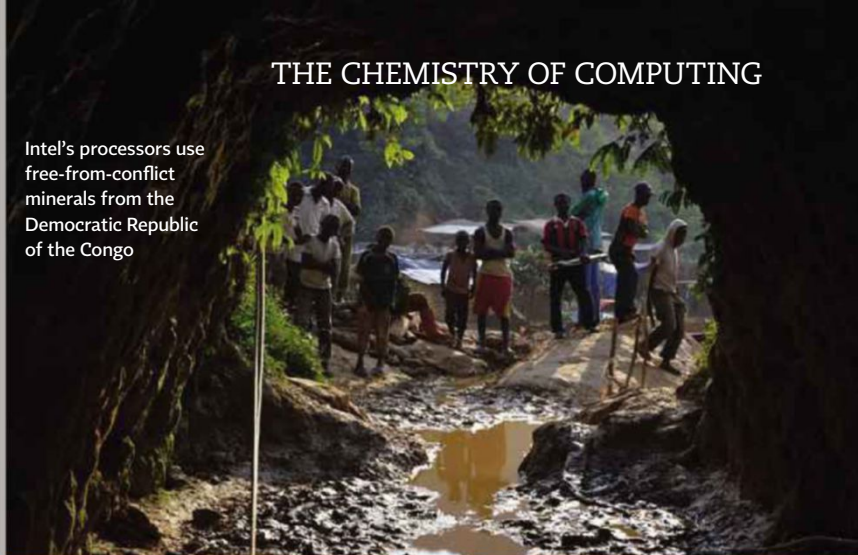


↑ Copper ores are extracted from some of the world's largest opencast pits

disks store the data magnetically, they don't rely on iron, which is the material most commonly associated with magnetism. In fact, the property required is referred to as ferromagnetism, which is the ability of a material to maintain its magnetism without the presence of a magnetic field.

In addition to iron, both nickel and cobalt are ferromagnetic, as you might guess from their proximity in the periodic table, and by creating alloys of these three elements, it's possible to fine-tune their properties. Such an alloy is used to form the first magnetic layer – referred to as the soft magnetic under-layer – and used to improve the performance of the layer in which the data is stored.

Intel's processors use free-from-conflict minerals from the Democratic Republic of the Congo



## The conflict-free challenge

With many of the elements that play a vital role in electronics manufacturing in short supply, the subject of conflict commodities is one that's becoming increasingly difficult to ignore. While conflict diamonds, often referred to in the press as 'blood diamonds', are the best-known example, a conflict resource is defined as any natural resource, extracted in a conflict zone, and sold to perpetuate the fighting.

Of particular relevance to computing is the Democratic Republic of the Congo (DRC), a major supplier of gold, the tantalum ore coltan, the tin ore cassiterite, and the tungsten ore wolframite. This war-torn country has endured 16 years of conflict, resulting in the deaths of 5.4 million people, with the fighting often funded by trading in these minerals by the militia.

Intel is keen to stress that all its processors are now conflict-free and it aims to make all products free of reliance on conflict minerals by 2016. While the simplest solution would have been simply to source these minerals elsewhere, Intel recognised that many people in the region relied on mining for their livelihood, so it adopted a different approach.

According to a spokesperson, "It is Intel's goal to use tantalum, tin, tungsten and gold in our products that do not directly or indirectly finance or benefit armed groups in the DRC or adjoining countries while continuing to support responsible mineral sourcing in the region. We're examining our supply chain to eliminate conflict minerals that finance violence."

This might be easy to say, but the journey has not been an easy one. Over a period of five years, Intel's supply chain team has visited 86 smelting companies in 21 countries, enduring the sometimes uphill struggle of persuading those companies to source minerals only from legitimate suppliers.

140th of the feature size of Intel's latest processors based on the 14nm technology.

With the platter now smooth and flat, the layers that play their part in actually holding the data can be applied. However, while hard



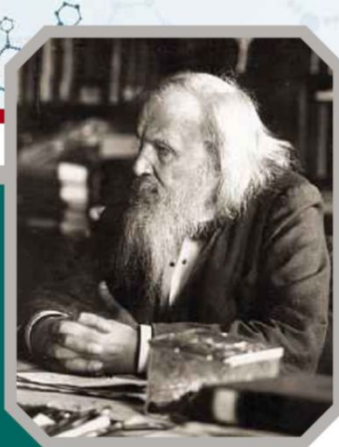
# It's all in a name

The names of chemical compounds can readily be understood since they relate to the names of the elements they contain. So, for example, silicon dioxide is made from silicon and oxygen, with two oxygen atoms for every silicon atom. Its chemical formula is therefore  $\text{SiO}_2$ . The names of the elements are often far more obscure, even though their derivations can be fascinating.

Some, such as mercury, uranium and neptunium, are named after planets. Americium, francium and germanium are named after their place of discovery, while others, such as einsteinium, are named in honour of a famous scientist. In contrast, the names of many of the elements that are found in our PCs may be puzzling at first sight, unless you're a Latin or Greek scholar.

Silicon, for example, comes from the Latin word 'silex', which means flint, a type of silica and hence a source of silicon. Hafnium, meanwhile, derives from Hafnia, the Latin name for Copenhagen, where the element was first extracted in 1923, 54 years after its existence was predicted by Dimitri Mendeleev. Phosphorous has a curious derivation, being a combination of the Greek words 'phos' and 'phorous', which means bearer of light. This is because phosphorous glows when exposed to oxygen.

Finally, although indium might appear to suggest it was first discovered in India, its origin is quite different. Discovered in 1863, it gives a flame a bluish purple hue, so the element's name refers to the colour indigo.



↑ Dimitri Mendeleev predicted the existence of Hafnium, a key component of Intel's processors, and also created the basis of the periodic table

gold, together with dissimilar elements including iron, copper, nickel. Removing these latter metals isn't too difficult but platinum and ruthenium are close neighbours in the periodic table, as are iridium, palladium, rhodium, osmium and gold, so extracting these from the mix is more demanding. Separating chemical substances involves exploiting differences in their physical or chemical properties, but the properties of the platinum group of elements are so similar that separation can take as long as six months.

## The liquid crystal story

If we were to delve into printed circuit boards such as a PC's motherboard or a graphics card, we'd find yet more chemicals that aren't found elsewhere in a PC. However, to complete our tour of the chemistry of computing we're going to look at the display. The LCD panel in a PC monitor, tablet or smartphone uses silicon transistors to turn individual pixels on and off, and these use similar materials to those in a processor. However, the curiously named liquid crystal, which is key to a display panel's operation, introduces a very different chemical.

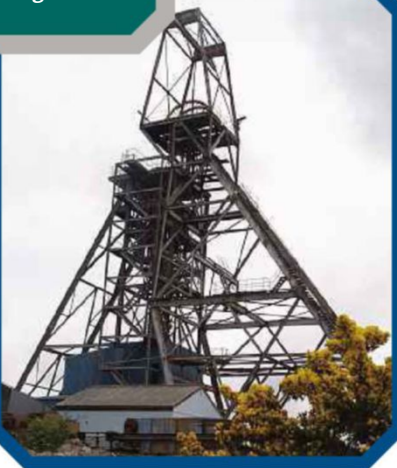
To cut a long story short, a liquid crystal is a material that, although liquid, has many of the properties of a conventional solid crystal. Importantly, their optical properties can be changed by the application of an electric field, and this in turn can make areas of the display either transparent or opaque. By applying an array of red, green and blue filters over the layer of liquid crystal, and placing a backlight behind the

liquid crystal, pixels in any of the three primary colours can be made either to glow in that colour or to be dark.

Most of the chemicals we've seen so far have either been elements or simple compounds. Common liquid crystals are organic compounds, which are much more complicated. An organic compound is one that contains carbon, although they nearly always contain hydrogen, while oxygen, nitrogen and a few other elements are also commonly found. Even organic compounds that contain just a few elements can be hugely complicated and, because there are so many ways in which the atoms of each element can bond together in the molecule, there's an almost infinite number of compounds that contain carbon, hydrogen, oxygen and/or nitrogen. Many of these compounds have very different chemical and physical properties, and a

few just happen to have the properties of a liquid crystal.

One of these liquid crystals is called MHPOBC, which is short for 4-(1-methylheptyloxy carbonyl)phenyl 4'-octyloxybiphenyl-4-carboxylate. However, that's quite a mouthful, and the straight chemical formula of  $\text{C}_{39}\text{H}_{49}\text{O}_5$  isn't particularly helpful, since there could well be quite different compounds with the same formula but with the atoms bonded together differently. It's common in organic chemistry to show a compound by its molecular structure, and we've



↑ Indium has been discovered in Cornwall's South Crofty tin mine, but without further investment it will never reopen

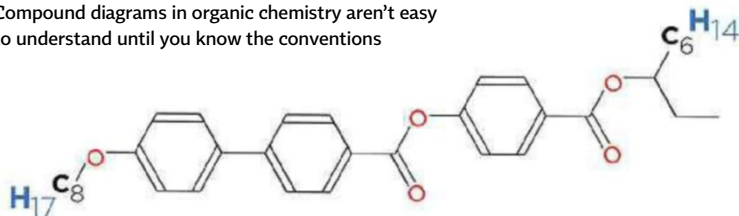
That data storage layer is also an alloy but now typically comprises cobalt, chromium and platinum. The chromium reduces cobalt's tendency to corrode, while the addition of platinum helps prevent data loss if the disk is subjected to external magnetic fields or excessive heat.

So far, most of the elements we've discussed haven't been especially rare. In terms of their abundance in the Earth's crust, neither cobalt, nickel nor chromium drop below 32nd position, and even chromium in 32nd place accounts for a fairly respectable 30 parts per million. All this changes as we look at platinum. Placed in 71st position, this element accounts for just 0.0037 parts per million of the Earth's crust, and it costs £26,000 per kilogram.

To improve the performance of the magnetic materials, they are composed of several sub-layers that have to be separated by ultra-thin layers of ruthenium. Fortunately only small quantities are required, however, since this element is rarer even than platinum, being the 73rd most abundant element at just 0.001 ppm, and annual production is just 27 tonnes, an amount that would fit in a 1.3m cube.

Some of these so-called transition metals aren't expensive solely because of their rarity but also because they're very difficult to extract from their ores. Platinum and ruthenium are found either as trace amounts in ores of other metals such as iron, or in metallic form as naturally occurring alloys. In either case, the ores often contain several of the so-called platinum group of metals plus

Compound diagrams in organic chemistry aren't easy to understand until you know the conventions



presented such a diagram below for MHPOBC to give an idea of its complexity. If you're not familiar with the convention, to simplify the diagram the carbon atoms are usually not shown but are present at the ends of any of the lines that designate chemical bonds, that don't show another type of atom, and are also present at any bends in the line. Similarly, hydrogen atoms are usually not shown but are assumed to be attached to the carbon atoms in sufficient numbers to ensure that all carbon atoms have the requisite four chemical bonds.

## The complete package

Liquid crystal alone doesn't make an LCD panel; far from it. When we bear in mind that an electric field is required to alter the optical properties of liquid crystal, it becomes clear that we need to sandwich the liquid crystal between a pair of electrodes that operate in conjunction with the transistor array at its rear. Most conductive materials that could form an electrode are opaque, though, so a specially formulated substance is required that is both electrically conductive and transparent. The material in question is called ITO and is a mixture of indium oxide and tin oxide. While tin is commonplace, though, the same cannot be said of indium, which is yet another of the elements on which our electronic devices rely yet is in depressingly short supply.

Despite the proliferation of LCD screens, there's only 0.16 part per million of indium in the Earth's crust, with some experts predicting that supplies will run out within the next five years. It's interesting to note that viable reserves of indium ore were announced a few years ago in South Crofty, the former Cornish tin mine that was in the process of being re-opened. Since then, and despite the computer industry's insatiable demand for both the tin that's used in solder and indium, the mine's future looks far from certain following the withdrawal of funding in 2013.

The other key element in a display is the backlight, which the liquid crystal pixels can block when turned on or off. These have recently moved from fluorescent tubes to LED backlights, and in these we find yet more unfamiliar elements.

LEDs work by electrically exciting the electrons in certain elements to a higher energy state. When the electrons return to their original energy state, light is emitted. The colour of the light depends on the difference between the energy



↑ Platinum, often mixed with other rare metals, is found predominantly in South Africa's Bushveld Complex

levels, and this can be fine-tuned by mixing several different elements. The white LEDs used for LCD backlights can either be made by combining red, green and blue LEDs or by adding a yellow phosphor to a blue LED. The elements used in manufacturing LEDs are either metalloids or are in the diagonal bands either side of the metalloids in the periodic table. Included here are aluminium, gallium, arsenic, phosphorous, indium, nitrogen, silicon, zinc and selenium.

It's undeniable that electronic engineering is one of the key technologies of the 21st century. Conversely, though, it would be wrong to consider chemistry as a science of previous centuries. As we've demonstrated here, chemistry and electronics are inextricably linked and it seems likely that chemists will play an important role in fuelling the electronics revolution for some time to come. After all, with silicon-based semiconductor technology approaching the limits of further scaling, and with many of the elements used in computing in short supply, it seems likely that developments in the field of chemistry will be the key to computing and communications of the future. Welcome to the new era of chemistry. ☑

## Recycle, recycle, recycle

In research labs around the world, scientists are seeking out new and more sustainable materials that could replace some of the rarer elements we rely on when supplies run out or become uneconomic to mine. In the long run it seems likely that carbon isomers such as graphene and nano-tubes or organic compounds may step up to the mark, but other solutions are being sought in the shorter term.

The European Waste Electrical and Electronic Equipment (WEEE) directive requires that provision is made for recycling electrical and electronic equipment. While its primary aim is to reduce the amount of electrical waste going into landfill with its associated environmental damage, it's also helping to increase interest in recycling. Much of this recycling takes place at a component level, but increasingly those components are being broken down to recover the sometimes rare materials that were used in their manufacture.

Printed circuit boards such as a PC's motherboard are commonly smelted to recover metals such as nickel, copper and perhaps even gold from the board and its components. Alternatively, by first removing the solder, its constituents of lead, tin and silver can be extracted. More challenging, but of intense interest due to impending shortages, is the recycling of indium. While recycling of the waste indium tin oxide from the manufacture of LCD panels is commonplace, recovering it from the panels of discarded equipment is much more difficult. Even so, scientists have demonstrated 94 per cent efficient recovery of indium from old LCD panels. However, at current prices it's doubtful whether the process would be economically viable.



The seven-metre high WEEE Man sculpture at Cornwall's Eden Project is made from the three tonnes of electrical waste each of us discards in a lifetime



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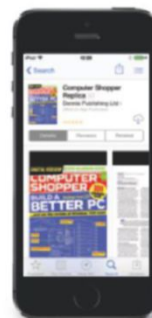
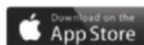
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## How to...

# Use Continuity with iOS 8

Got more than one Apple device? You can make and receive phone calls on all your iOS 8 devices using the Continuity feature. **David Ludlow** shows you how

**WITH iOS 8**, one of Apple's goals was to integrate all its products more tightly, so that they can use and share features between them. As a whole, this set of features is called **Continuity**, and the innovation that most people will probably appreciate is the ability to make and receive phone calls from any device.

The feature only works with OS X Yosemite. The plan is to extend support to SMS messages as well, so you'll be able to send and receive texts from iOS 8 and OS X Yosemite devices. This latter feature will have to wait until iOS 8.2, however. In the meantime, we'll explain how to use Continuity for phone calls.

### 01 SIGN ALL YOUR DEVICES INTO iCloud

The first and most important requirement for Continuity is that you're signed into the same iCloud account for all your devices. You can check by going to Settings, General, iCloud. If you're not signed in, tap the Sign In button and enter your account details. If you're signed in to the wrong account, tap Sign Out and then sign in with the correct details.



### 02 JOIN THE SAME WI-FI NETWORK

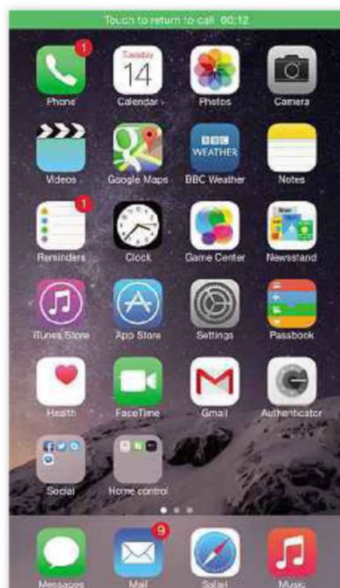
Your devices must also be connected to the same Wi-Fi network. This is so that Continuity phone calls work only with devices that are within reach of each other. After all, having your iPad ring at home when you're at work isn't particularly useful.



### 03 RECEIVING CALLS WORKS AUTOMATICALLY

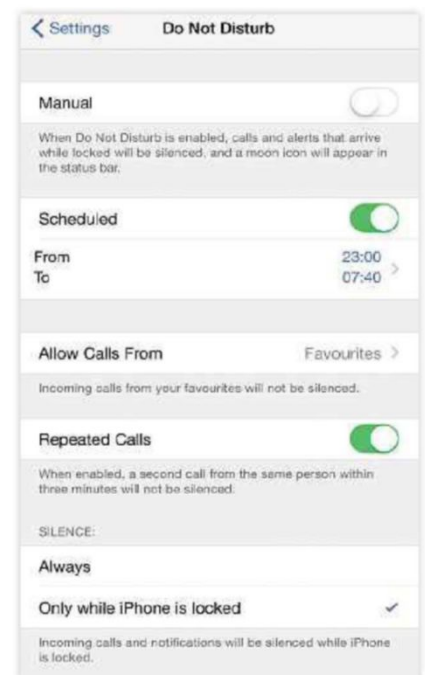
The great thing about Continuity is that it's completely seamless and works immediately. So when someone calls your phone, your iPad (or other iOS device) will ring automatically. You can pick up a call from any device by tapping the Accept button. When answering, your iOS device will switch to the most appropriate mode for the call: your iPad, for example, will answer in hands-free mode. Calls such as this are sent from your phone to your other device over your home network, so there's a small delay.

If you want to switch to your phone, just pick up your iPhone and tap the green 'Touch to return to call' bar at the top of the screen. You'll now be able to use your phone as normal.



### 04 MANAGING DO NOT DISTURB

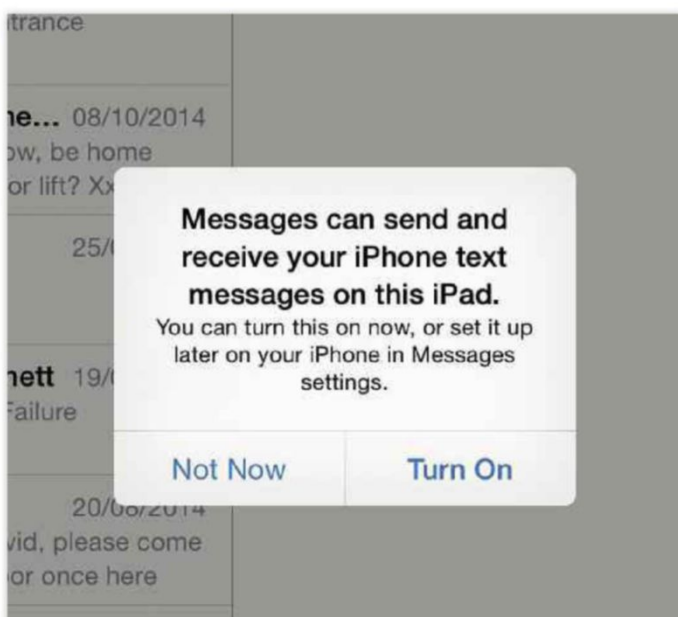
Do Not Disturb is a great feature that lets you leave your phone on, muting calls and texts. All devices obey the Do Not Disturb rules that you set on your iPhone, so if you get a call in the middle of the night, your iPad won't ring if your phone's set to silent. Any callers that you manually set to allow through Do Not Disturb override the rules. Similarly, if you leave the default 'Only while the iPhone is locked' option, your iPad will ring if your phone is unlocked.





## 05 MAKING A PHONE CALL

If you want to make a normal phone call from another device, just open the FaceTime app. You can use the Video or Audio option; it doesn't matter which. Enter the phone number you want to call (you can also search contacts on your device), tap the phone icon, then select your iPhone from the dialog box. Your phone call will be made via your iPhone. If you want to move to your phone, you can tap the Green bar at the top of the screen to take over the phone call.

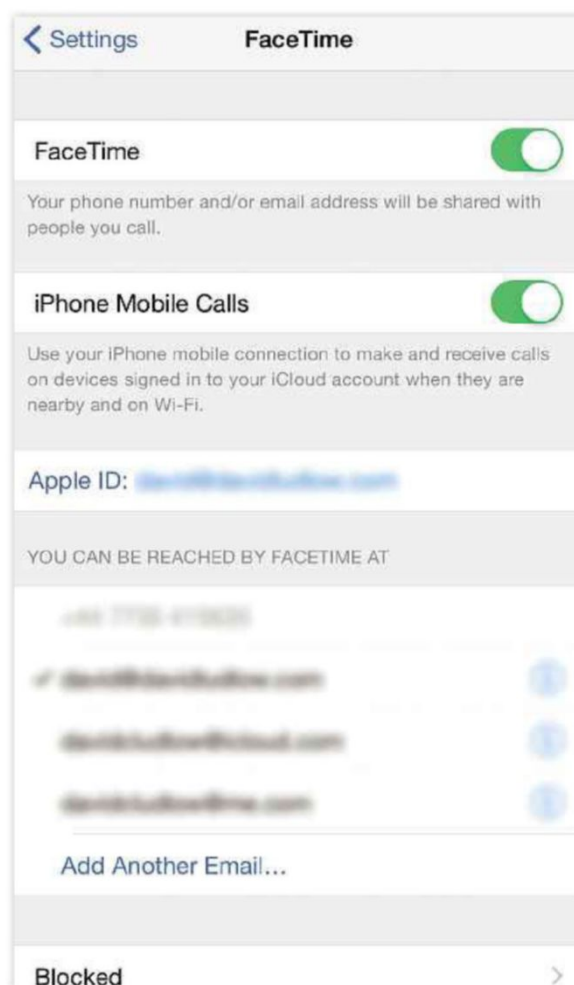


## 06 TURN ON TEXT MESSAGES

Apple devices running iOS 8 or OS X Yosemite can also send and receive messages via your iPhone. Unlike with phone calls, your devices don't have to be on the same network, as your iPhone will upload incoming SMS messages to the cloud, so that all your devices can receive them. When you send an SMS, it's uploaded to the cloud, where your iPhone picks it up and transmits it via its mobile network.

Just start the Messages app on any of your Apple devices and you'll see a pop-up message asking if you want to enable sending and receiving text messages on this device. Select Turn On. You'll see a new window with a code in it, which you must enter on your iPhone, tapping Allow to give the new device access to your SMS messages. If you don't see the pop-up message, follow Step 8 to force the prompt.

You can now send and receive all standard text messages on that Apple device; repeat for all the devices you want to have access.




## 07 HOW TO TURN CONTINUITY PHONE CALLS OFF

If you don't want to use this option on one of your devices, go to Settings, FaceTime and turn off iPhone Mobile Calls. Continuity phone calls will be disabled on this device until you re-enable it. Note that all your other devices will continue to work as normal.



## 08 DISABLE MESSAGES ON A DEVICE

To stop a device sending and receiving messages, go to your iPhone and select Settings, Messages, Text Message Forwarding. Use the slider switches to choose the devices on which you want to enable messages. To re-enable a device, just turn the slider back on. This will display a message containing a code on the device; enter that code on your iPhone to turn on messaging again. 



# Business Help

If you have database, office application and macro issues, **Kay Ewbank** can help. Send your problems to [businesshelp@computershopper.co.uk](mailto:businesshelp@computershopper.co.uk)



## Rotate text in PowerPoint

**Q** I'm using PowerPoint 2010, and there doesn't seem to be any way to rotate text in a shape through 180°. I'm looking in Format Shape, Text Box, Text Direction, and I can see options for 90°, 270° or stacked. What am I missing?

Don Potts

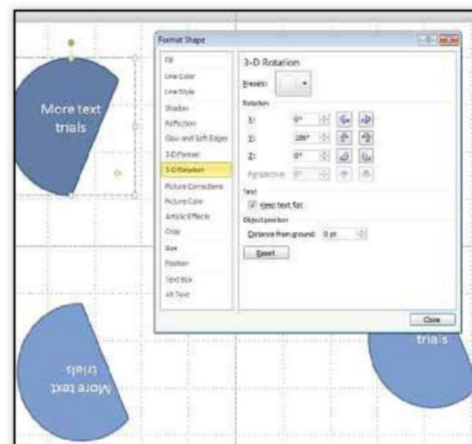
**A** There is a way to rotate the text by 180°, though we agree that it does seem odd not to have offered it in the dialog you mention.

What you need to do is rotate the entire shape by selecting it then rotating it so that the whole thing is upside down, including the shape and the text inside it. You can do this by clicking on the green dot at the top of the selection rectangle and

dragging it round to the bottom so that the entire shape has rotated.

Then make sure the shape is selected, right-click and choose Format Shape, 3-D Rotation. In the 3-D Rotation options, make sure you put a tick in the box labelled Keep text flat, and set the Z rotation amount to 180. The option to keep text flat prevents text inside a shape from rotating when you rotate the shape. When this option is selected, the text is always on the top of the shape. When this option is cleared, the text inside of the shape follows the shape's front surface as it rotates.

If your shape is symmetrical – so it won't matter which way up it is – you can skip the initial rotation using the green move/rotate handle.



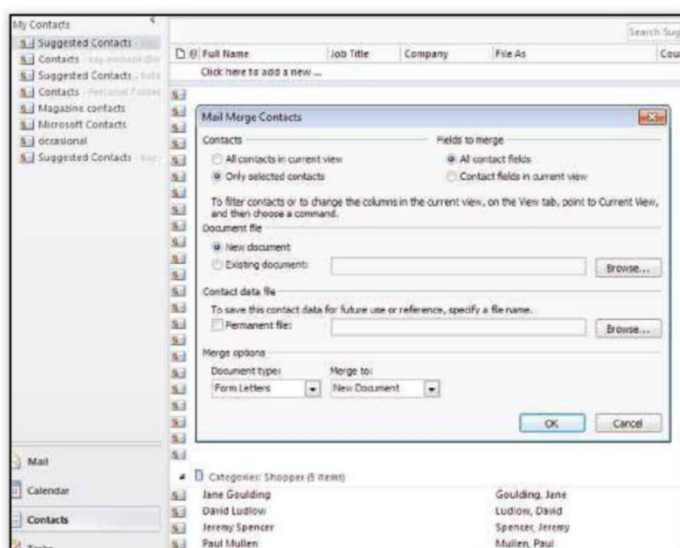
↑ Make sure the option to keep text flat is selected when rotating shapes in PowerPoint

## Mailing labels in Outlook

**Q** I need to print mailing labels from Outlook, but I only need to send them to a specific category from the contacts list. Unfortunately, I can't find how to use the category to select the recipients. I've found instructions telling me how to hand-select the contacts from scratch then start the process, but according to Microsoft technical support I can't use the existing list.

Is this correct? There are hundreds of names in my category, and I don't want to have to select them all by hand again.

Chris Robson



↑ Use Selected Contacts as the data source for a mail merge to limit which records are printed in Outlook

**A** All the versions of Outlook that we know of let you use categories to select a subset of names for mailing labels, but just in case we're missing something in a combination of Outlook 365 and the web version, we'll also show a workaround that should work no matter what combination you're using.

First, in Outlook 2000 onwards, set the view to Group by Category. If this isn't available, select the List view and click the Categories icon. Either way, select the category you want to use in the mail merge by clicking on its title. You can now select the Mail merge option (from the Tools menu or the Actions area on the Home tab, depending on your version of Outlook). In the dialog that appears, make sure you use the option for basing the merge on the selected contacts rather than all of the contacts. If this is a mail merge you're going to use frequently, you can create a custom view that filters out the other categories.

If there's something we're missing (probably to do with the Outlook Web version in Office 365) and you don't have the choice of using Selected Contacts, you can still achieve your aim. Make sure you've named your category using a readily identifiable name. Now export your contact list to a comma-separated file (CSV). If you open it in Excel, the contacts in your named category will each be identified in the column labelled Categories by the name of your category. You can now sort on that column using Data, Sort, then specifying the Categories column – in our case this was column BC. Once you've sorted the names, delete all the names that aren't in your category. You can now save the file, and use that as the basis of your mail merge.

## Format Word table of contents

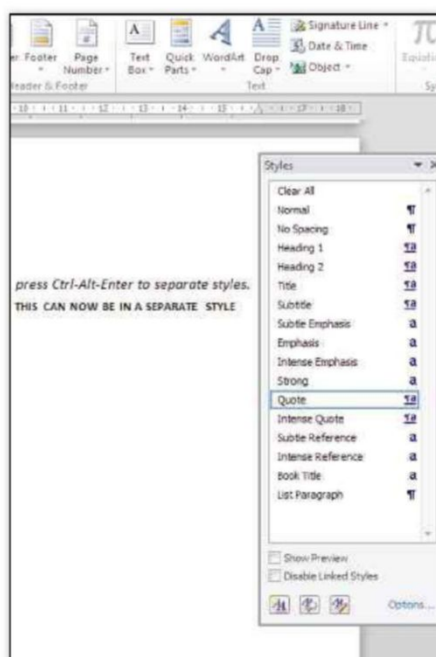
**Q** I'm laying out a document in Word 2010, and I want to have a table of contents created automatically. My problem is that I want to pull only the first short phrase from each paragraph for the TOC, but I want to have the phrase in line with the rest of the paragraph. I've tried to apply two styles to the same paragraph, but I can't see any way to do it without having the subheading on a separate line. Is there a way to make a style apply to only part of a paragraph? When I've tried changing the style of a few highlighted words at the start of the paragraph, Word automatically changes the entire paragraph to that style. I'm using my own customised styles, if that makes a difference.

John Milburn

**A** You can have multiple styles in the same paragraph using Word's Style Separator, but it's a bit fiddly to apply to existing text. The style separator is actually a hidden paragraph mark that marks the boundary between separate styles applied in a document. You only see the style separator mark if you view non-printing characters.

To view the style separator in Word 2007, click Options on the Tools menu. On the View tab, click to select the All check box under Formatting Marks, and then click OK. In Word 2010, you need to use File, Options, Display, and select the option to display all Formatting Marks. Style separators look like paragraph marks with a dotted line around them.

The easiest way to see the style separator in action is when typing a new paragraph within existing text. Try the following to see it in action. Select a style, such as quote, and begin typing. Type a few words, then press Ctrl-Alt-Enter. If you have another paragraph



↑ Use Ctrl-Alt-Enter to set up two text styles in the same paragraph

following your formatted text, you'll see it being moved up so it immediately follows the formatted text. You can then apply another style to the second part of the paragraph.

The way to get two styles in the same paragraph is to split your paragraph into two at the point you want the style to change, so that it becomes two paragraphs. Set the style for the first portion of text, then set the style for the second portion of text. Now place your cursor at the end of the first portion of text, press Ctrl-Alt-Enter and the two paragraphs will be merged to appear as a single paragraph with two styles.

## Independently move Access controls

**Q** I'm creating a form in Access 2010, and I want to alter the layout of the controls on the forms and how their labels are aligned. The controls were all placed on the form bound to the background grid, and the field labels and text boxes for the data were entered in the standard way, so when you move a text box, the label moves too. I want to alter the spacing between the control and the label; how can I split them?

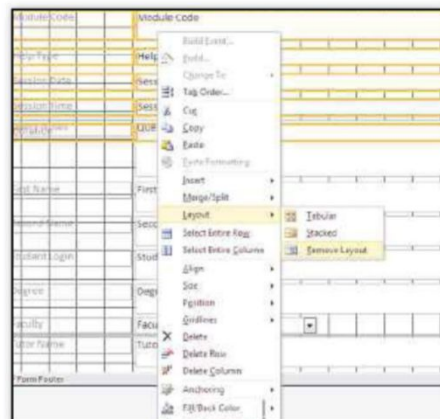
Sue Hope

**A** If you enter the controls one at a time, you can do what you want in two ways. Select the part you want to remove (either the text box or the label). An orange rectangle will appear around the control, with small grey rectangles at the top left and right corners of the box. Click on the left-hand rectangle, and you can pick up and move the label. Click on the right-hand one, and you can pick up and move the text box.

However, the label and the control are still linked, so if after moving the label or the text box, you then re-select either part and move it, the other half will move relative to it.

If you want to split the two so they can be moved independently, you need to select the label, delete it using Ctrl-X, then paste it back using Ctrl-V. You'll then be able to move the label (and/or the text box) without moving the other part of the label/text box pair.

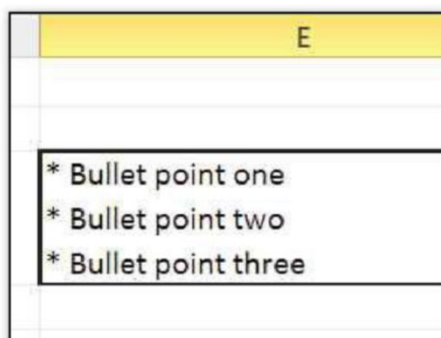
All this lets you move a single control or label. There is another possibility, which is that you have a table or stacked set of controls on your form, and it's these you want to move. To do this, you need to select the entire group of controls and right-click on them. In the pop-up menu that appears, select Layout, Remove Layout. This will get rid of the grouping for the controls and let you move them one at a time.



↑ Use Layout, Remove Layout to make controls movable independently in Access

## Multiple lines in an Excel cell

**Q** I'm creating a table in Excel where I'd like the entries in one of the columns to occupy multiple lines. What I want to do is to have several bullet points in



↑ Use Alt-Enter to split lines of text in Excel

the same cell, so one cell might have:

Bullet point one  
Bullet point two  
Bullet point three

Is there a way to do this other than by using the space bar? If I press the Enter key, the value is placed into the next cell below. I wondered if I needed to merge cells, but my problem is that this is only part of a larger table and I don't want to merge the cells in the other columns.

Anne Maxwell

**A** Yes, you can do what you want. When you get to the end of the text for the first bullet point, press Alt-Enter. You'll get a new line in the same cell.



# Helpfile

Whatever your general PC, hardware and software woes, **Simon Handby** is here to help. Send your problems to [help@computershopper.co.uk](mailto:help@computershopper.co.uk)



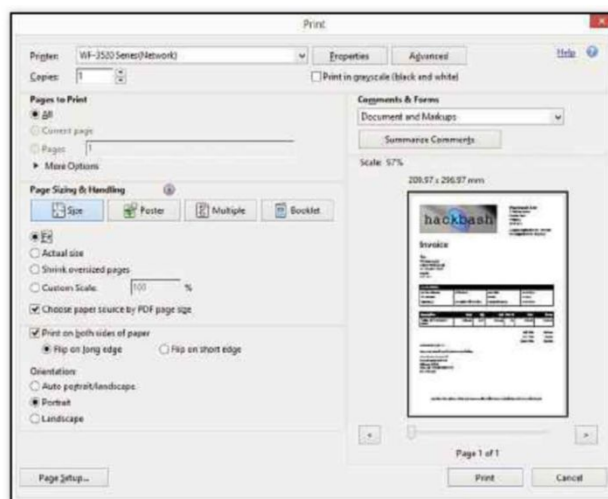
## I can't print PDFs

**Q** I've got a Windows 7 computer and a Canon Pixma iP4850 printer, which is connected via USB, and with which I haven't previously experienced any problems. Recently, when I came to print out a PDF document from Adobe Reader, the document would not print and the whole computer locked up and needed rebooting. This occurred after downloading my bank statement as a PDF, but I've done this before without issue. All other documents print OK.

I have uninstalled Adobe Reader using the Adobe Reader and Acrobat Cleaner Tool, and reinstalled the latest version of the program. I have also installed the latest printer driver, all to no avail. I even tried an earlier version of the Adobe Reader program. The problem still exists and I am desperate to print some PDFs that I have. Can you help? Should I install a different PDF reader?

John Wyles

**A** You've already tried the first steps that we'd recommend, but you might also try running the print troubleshooter. Open the Start menu, search



Reader's scaling options can cause problems on some printers

for troubleshooting and run Troubleshooting from the results. Click the Hardware and Sound category, then select Printer and click Next to start the process. It's possible that this will detect and fix errors, but if not the suspicion falls on Adobe Reader. Installing a third-party PDF reader would let you verify

that the PDFs themselves will print from other software.

Assuming that they do, we'd look for a setting that might be causing problems in Reader. Our first suggestion would be to check the options within the print dialogue itself: double-check that the correct printer is selected, then try moving the page size from Fit to Actual size. You might also try changing the option under Comments & Forms from Document and Markups to Document.

If that doesn't work, the problem could be something to do with Reader's protected mode, which has caused some

users print problems in the past. From the Edit menu, select Preferences and open the Security (Enhanced) tab. Untick Enable Protected Mode at startup, agree to the confirmation message then close the Preferences window, close Reader, wait a few seconds and restart it, then test again.

## Stop downloading videos!

**Q** I've just upgraded my Nexus 5 phone to Android Lollipop, and we still seem to be on speaking terms. I've got a problem, though: I use Firefox, and when I first tried to view a video online it asked whether I wanted to download it or view it with the Photos app. I thought I didn't want to do either – I just wanted videos to play automatically as they had done before – but after being asked a few times I told it to download. Now every time I try to view a video in a web page it ends up downloaded to my phone. How can I stop this and see the question again?

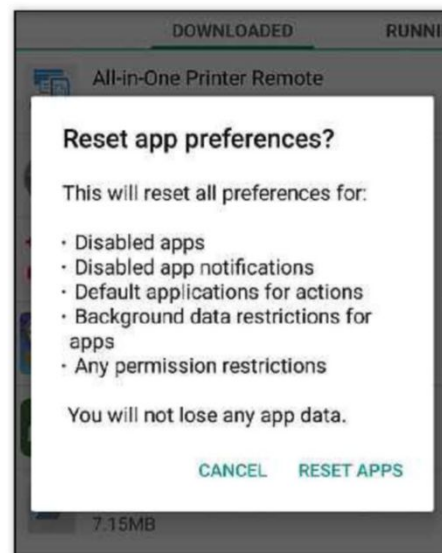
Matthew Sykes

**A** You need to reset the app preferences for video content on the phone. One way to do this would be to install a new video player app;

the phone would understand that it had a new option for playing video and would offer it as a choice next time you tried, along with the other two choices you've mentioned. Otherwise the only option we know of is to reset all your app preferences, which would be a slight frustration as you'll need to choose your options again for all other types of content and action.

To do this, drag down the notification bar and tap the blue icon, then tap the gearwheel icon next to it. Scroll down the Settings page and tap Apps, then tap the three-dot menu icon at the top right and choose Reset app preferences. Read the warning, and tap Reset Apps. You'll now have to tell the phone which apps to use as you open various content.

➔ Resetting Android's app preferences will give you another chance to select your default options



# Bandwidth on the run

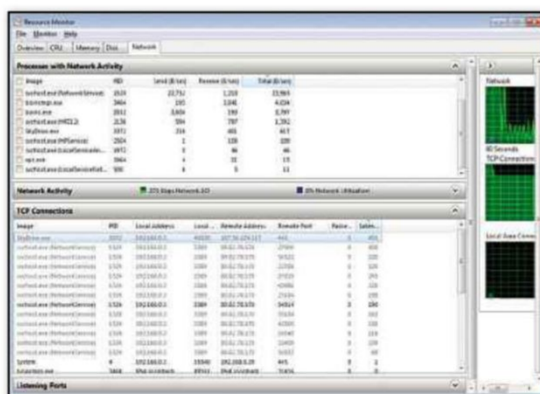
**Q** I have a small network of five computers, and recently replaced a Windows XP Pro PC with one running 64-bit Windows 7 Professional, but it's driving me mad! It seems to be responsible for almost continuous internet traffic, which makes web browsing on any of the PCs virtually impossible given my slow broadband connection. I know my new PC is responsible because if I pull out the Ethernet cable my router immediately goes quiet, and if I reconnect it the router bursts into activity again.

I have an active Microsoft Office 365 Home subscription on this machine and I know that Microsoft OneDrive is part of this package, but the problem persists even if I close down OneDrive. Using Resource Monitor I have tried to identify which application(s) might be responsible for the internet activity, but this merely shows that most of my TCP connections are initiated by svchost.exe (Network Service), which doesn't really help very much.

Your initial response highlighted that in the Resource Monitor screenshot I supplied, most instances of svchost.exe are contacting the IP address 80.82.78.170, and an IP lookup tool suggested this address belongs to the Dutch internet host Ecatel. You were also concerned that it serves the domain 'hosted-for-minecraft.net', but that it doesn't match the DNS records for that domain. In short, either it was a poorly configured server or there's something fishy going on.

You initially suspected the latter, as each instance was using the local port 3389, used by the Remote Desktop Protocol (RDP), but I connect remotely to this PC myself, so there's a firewall rule to forward incoming connections on port 3389 to this PC. I do suffer virtually continuous attempts to compromise my system via RDP, but I'm confident I've used a secure login password.

David Hobbs, david@dch.me.uk



David's screenshot suggests a suspicious number of remote desktop sessions with a suspicious IP address

**A** We were alarmed by the attempted RDP connections to your PC. To improve security in your RDP firewall rule you should reduce the permitted remote IP range to the minimum possible, and also schedule the rule so it's disabled when you're at home. If your remote-access client lets you configure which TCP port it uses, it might help to set it to a higher numbered port. Ideally, choose a single port in the range 49,152-65,535 and configure your firewall to forward from that external port to port 3389 of your PC. Combined, these steps should reduce the number of RDP attempts you get, as fewer people will have access to the exposed port.

Several utilities can help shed light on a computer's network traffic, but in this case we'd recommend NetBalancer (free from netbalancer.com). Install and run the software, and from the Window menu select Process Info. Next, click the Downloaded or Uploaded column headings to sort processes by network use, with the heaviest at the top. Select any process you want to discover more about and click the Process Info tab at the bottom of the window. In the case of svchost.exe – any instance of which might handle processes on behalf of multiple DLLs – this will at least reveal which services are related, which could help narrow things down.

# Withdrawing my trust

**Q** I've never ticked the box you get when installing software that says 'Always trust software from...' – what if that company changes hands or policies and you subsequently can't trust them? I can't have been paying attention the other day when updating the software for my Brother printer, however, and I accidentally agreed to trust all Brother's software. Annoyingly, I can't find a way to undo this mistake. Can you help?

Richard Upton

**A** Windows makes it easy to trust a company's software and updates, but it's not so obvious what to do if you change your mind. First, open the Start menu or Start screen, type 'MMC' (without the quotes) and hit Enter. When the Management Console starts, open the File menu, choose Add/Remove Snap-in..., double-click Certificates in the list, and when prompted choose Computer account. In Windows 7 click Finish, or in Windows 8 click Next then Finish, then click OK to accept and dismiss the dialog.

In the main pane, double-click Certificates, then double-click Trusted Publishers. Finally, double-click Certificates within this to see the list of companies you've previously trusted. Individually select any that you want to remove, press Delete and agree when prompted. The next time you install or update that company's software you'll be asked for permission, just as you were before.



It's easy to trust a company's software, but more difficult to stop trusting it

# Find my old Android rail app

**Q** A few years ago when I bought my first Android phone there wasn't a Network Rail app. Instead, I paid £3 or so for an excellent third-party program I've used ever since. Recently I bought a new phone, my trusty app didn't re-install, and I couldn't find it on the Play store. I tried the train company's app, which was awful, and I didn't much care for the National Rail or the Trainline apps. Is there any way to get my old app back?

Steve Lomax

➔ Search My apps at the Play store to find apps you've previously used



**A** It's frustrating to lose a good app that you've paid for, but if it's disappeared from the Play store it's likely that it's no longer updated or supported. That said, if you're talking about the Cworkor Train Times UK app, this does appear to work on both Android Kit Kat and Lollipop, so you should be able to reinstall it.

Go to the Play store, tap the menu icon at the top left, tap My apps, then tap the All tab, which will list all the apps associated with your Android account in reverse chronological order. Keep scrolling down until you find Train Times UK (or the app you have in mind), tap it, then tap Install on the app page. ☑



# Make a multiroom audio system with Raspberry Pi

PART  
1

In the first of a two-part article, **Clive Webster** shows you how to save money and boost your geek credentials by making your own wireless audio system



**AS SHOWN IN** our group test last month, multiroom audio systems are a must for music lovers. You can listen to a song in the kitchen and you don't need to do anything to enjoy the same track as you move into the dining room for your meal. You can control playback from your smartphone or tablet, or even set different moods for different rooms at a house party by playing a funky playlist in your living room and a calmer selection in the kitchen. The problem is, many multiroom audio systems install a secondary wireless network, and the speaker units can easily cost £300 each. By using a Raspberry Pi, your own wireless network and a NAS or PC as a server, however, you can make your own high-quality wireless speaker units for around £100 each.

## GETTING STARTED

As the basis for the system we've chosen Logitech's Squeezebox NAS software (also known as Logitech Media Server, a common app on most NAS units) and a Raspberry Pi. We used a Raspberry Pi B+, as it was the cheapest at the time of writing and has four USB ports. We'll need these ports as for this project we've decided to use a USB sound



↑ Whatever speakers you decide to use, the basic setup is a Raspberry Pi B+, case, 2A Micro USB power supply, 8GB USB card, Wi-Fi dongle and USB sound card. Total cost? £50.50

card; the crackly integrated Pi audio output just isn't good enough for music. We chose to use a simple £3 USB sound card bought from [thepihut.com](http://thepihut.com) as it does the job and is natively supported by the Raspbian operating system. However, you could use a fancy USB sound card such as Creative's Sound Blaster Play! (£18 inc VAT from [www.comwales.co.uk](http://www.comwales.co.uk)). See [tinyurl.com/pisoundcards](http://tinyurl.com/pisoundcards) for a full list of Pi-compatible USB sound cards and installation instructions. The other ports will be taken up with the Wi-Fi dongle (see below) and a keyboard and mouse for setup. You could of course use a USB hub to set up a two-port Pi.

We chose Edimax's EW-7811Un Wi-Fi dongle as it's tiny, only £6 and is natively supported by Raspbian, so we won't have to faff around installing a driver. Other Wi-Fi dongles are also natively supported by Raspbian; any shop-branded dongles from [www.modmypi.com](http://www.modmypi.com) or [thepihut.com](http://thepihut.com) will be fine, and there's a full list of compatible dongles at [tinyurl.com/piwifidongles](http://tinyurl.com/piwifidongles). Although specialist Raspberry Pi resellers sell microSD cards pre-loaded with Raspbian, it's easy enough to install it yourself on a cheap card. We chose an 8GB Class 10 microSD card and SD adaptor, which cost just £3.50 on Amazon.

We used the cheapest clear case we could find for our Pi B+, which was Multicomp's Clear Case at £5. Clear cases let you see the Pi's power and activity lights, but to reduce light pollution in your living room, you could

use any case you like. You could even build a case from spare Lego to house the USB sound card neatly and hide the Wi-Fi dongle's flashing activity light. As the Wi-Fi dongle is power-hungry, and the Pi is powering a USB sound card as well, opt for a 2A power supply. Resellers [www.modmypi.com](http://www.modmypi.com) and [thepihut.com](http://thepihut.com) sell such supplies for a fiver.

To round off your speaker unit, you'll need speakers. Creative's GigaWorks T20 Series II is a high-quality set of powered stereo speakers, but you can use any 2.0 or 2.1 speakers you like as long as they have their own power supply. Our shopping list shows the parts for a single wireless speaker unit; for a multiroom audio setup, you'll need one set per room.

## WI-FI HI-FI

Whichever speakers you choose, the build process starts by downloading the latest version of Raspbian from [www.raspberrypi.org/downloads](http://www.raspberrypi.org/downloads), as well as SD Formatter 4.0 from [www.sdcard.org/downloads/formatter\\_4](http://www.sdcard.org/downloads/formatter_4), Win32DiskImager from [sourceforge.net/projects/win32diskimager](http://sourceforge.net/projects/win32diskimager) and PuTTY from [tinyurl.com/putty-ssh](http://tinyurl.com/putty-ssh). While Raspbian is downloading, you could put the Pi in its case.

Once downloaded, extract the Raspbian image from its zip file. Put the microSD card into the SD adaptor and insert this into your PC; wipe the SD card with SD Formatter and then install the extracted Raspbian.img file on to the SD card using Win32 Disk Imager.

## SHOPPING LIST

### Speaker unit

Raspberry Pi B+	£28
<a href="http://thepihut.com">thepihut.com</a>	
8GB microSD card	£3.50
<a href="http://www.amazon.co.uk">www.amazon.co.uk</a>	
Power supply	£5
<a href="http://thepihut.com">thepihut.com</a>	
Wi-Fi dongle	£6
<a href="http://thepihut.com">thepihut.com</a>	
USB sound card	£3
<a href="http://thepihut.com">thepihut.com</a>	
Multicomp Clear Case	£5
<a href="http://thepihut.com">thepihut.com</a>	
Creative GigaWorks T20 Series II speakers	£58
<a href="http://www.cclonline.com">www.cclonline.com</a>	

**Total £108.50**

```

pi@raspberrypi:~$ nano /etc/wpa_supplicant/wpa_supplicant.conf
GNU nano 2.2.6 File: /etc/wpa_supplicant/wpa_supplicant.conf Modified
ctrl_interface=DIR=/var/run/wpa_supplicant GROUP=netdev
update_config=1

network={
    ssid="your_ssid"
    psk="your_2.4GHz_password"
}
  
```

↑ Allow your Raspberry Pi to log on to your wireless network automatically by editing the wpa\_supplicant config file

```

pi@raspberrypi:~$ ifconfig
eth0:  Link encap:Ethernet  HWaddr b8:27:eb:c3:14:52
       UP BROADCAST MULTICAST  MTU:1500  Metric:1
       RX packets:0 errors:0 dropped:0 overruns:0 frame:0
       TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
       collisions:0 txqueuelen:1000
       RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

lo:    Link encap:Local Loopback
       inet addr:127.0.0.1  Mask:255.0.0.0
       UP LOOPBACK RUNNING  MTU:65536  Metric:1
       RX packets:8 errors:0 dropped:0 overruns:0 frame:0
       TX packets:8 errors:0 dropped:0 overruns:0 carrier:0
       collisions:0 txqueuelen:0
       RX bytes:1104 (1.0 KiB)  TX bytes:1104 (1.0 KiB)

wlan0:  Link encap:Ethernet  HWaddr 74:da:35:00:79:a3
       inet addr:192.168.1.117  Bcast:192.168.1.255  Mask:255.255.255.0
       UP BROADCAST RUNNING MTU:1500  Metric:1
       RX packets:740 errors:0 dropped:4 overruns:0 frame:0
       TX packets:278 errors:0 dropped:0 overruns:0 carrier:0
       collisions:0 txqueuelen:1000
       RX bytes:157125 (153.4 KiB)  TX bytes:44592 (43.5 KiB)

pi@raspberrypi:~$
  
```

↑ Check that the Raspberry Pi has a valid IP address for your network with the 'ifconfig' command

Once Raspbian is written to the SD card, take the microSD card out of the SD adaptor and insert it into the Pi. Next insert the Wi-Fi dongle and a USB keyboard, then plug in the Micro USB power adaptor. Log into the Pi with the standard credentials (pi, raspberrypi) and then type 'sudo raspi-config'. Hit Enter to select the first option, Expand the filesystem. Once the Pi tells you the file system has been expanded, change the password (option 2) by pressing down arrow, Enter and following the instructions. Exit and reboot the Pi by pressing the right arrow twice and hitting Enter.

Log in again and you're ready to set up the Wi-Fi dongle. Edit the wpa\_supplicant config file by typing 'sudo nano /etc/wpa\_supplicant/wpa\_supplicant.conf' and pressing Enter. Add the following at the end of the file (using your SSID and Wi-Fi password, remembering that you'll have to use your 2.4GHz network unless your Wi-Fi dongle is very fancy):

```

network={
    ssid="your_ssid"
    psk="your_password"
}
  
```

Save and exit by pressing Ctrl+X, Y and then Enter. Check the change works by typing 'sudo reboot', log back in once the Pi has rebooted and then type 'ifconfig' to display the Pi's network settings. You should see a

You could even build a case from spare Lego to house the USB sound card neatly and hide the activity light

section for 'wlan0' and an IP address that's in line with other IP addresses on your network, probably something like 192.168.1.xxx.

Before updating your Pi you should uninstall Wolfram Engine, as this can interfere with this project, isn't required and massively slows down the updating process. Once Wolfram is uninstalled, you can update Raspbian and its applications as normal:

```

sudo apt-get remove -y wolfram-engine
sudo apt-get update
sudo apt-get -y upgrade
  
```

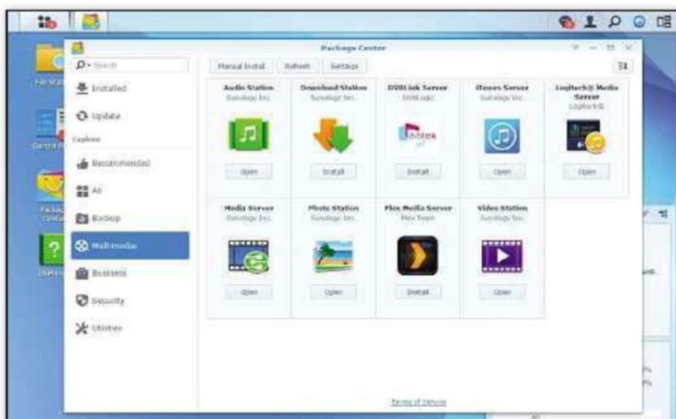
## SQUEEZEBOX

As the Pi updates, log into your router and give the Pi and the server you're going to use for Squeezebox (in our case, a Synology NAS) a static IP address. Each router manufacturer has a different process for assigning static IPs, so refer to your router's manual or the manufacturer's website to see how to do it. Save your changes and log out of your router.

If your Squeezebox server isn't already loaded with your music, find the server on your network and copy your music files from your PC (or PCs) to a Music folder on your Squeezebox server via your normal file browser (Explorer for Windows PC, for example). Once you're happy that your Squeezebox server is loaded with tunes, log into the server's web page and install Logitech's Squeezebox app (this might be called Logitech Media Server, as on a Synology NAS). Launch the app and you'll be asked to create a free Squeezebox account, so do so and then log into Squeezebox using those credentials.

Now run the newly installed NAS Squeezebox app. The app should be simple to set up; you just point it at the Music and Playlists folder on your Squeezebox server and click Next. On our Synology NAS the automatically created Music folder is located in 'volume1', as shown in the image below. We didn't have a Playlists folder, so just pointed Squeezebox at the Music folder again.

Once Squeezebox has scanned and created your music library, you'll see the main Squeezebox web page. If you add music to your Squeezebox server in the future, you'll have to click on the Settings button at the bottom-right and then click the Rescan button on the settings page that appears to make sure it's added to the library.

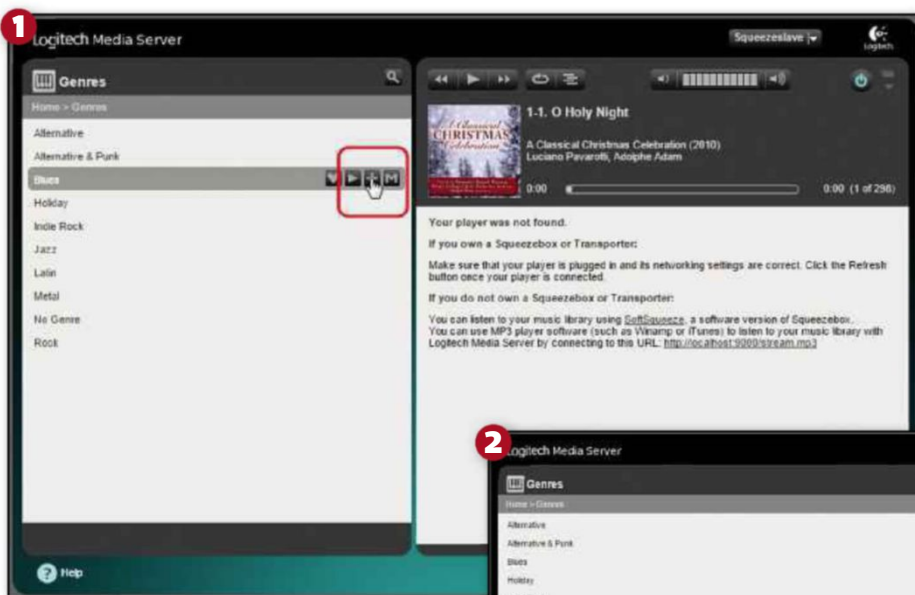


↑ Logitech's Squeezebox app might be called 'Logitech Media Server' on your media server – it was on our Synology NAS

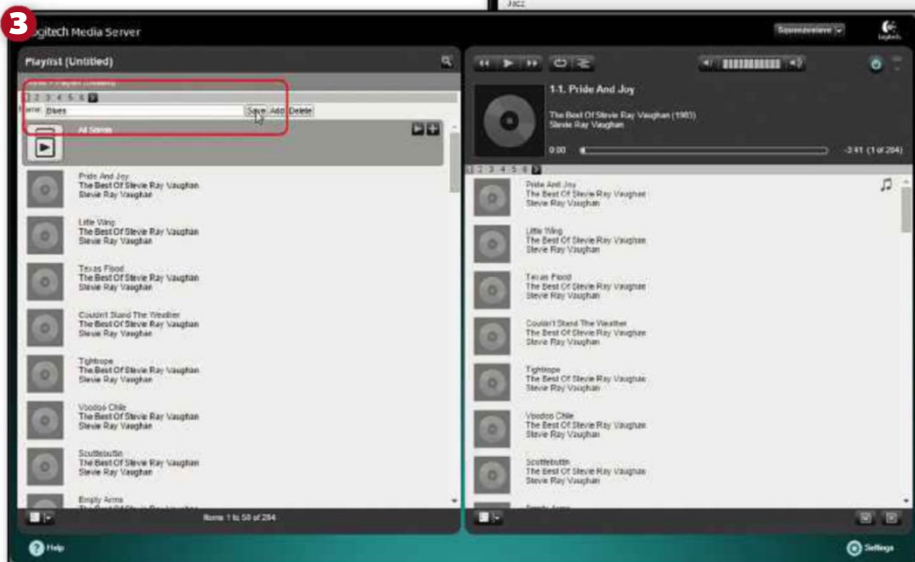


↑ Just point Squeezebox at the Music folder of your NAS (or alternative media server) and it will create your music library automatically





If you browse by genre, album or artist you can add all Blues tracks to a playlist with a single click, for example



The easiest way to use Squeezebox is to create playlists, but this is a little clunky. You have to browse your music library in the left-hand pane of Squeezebox and add tracks to the right-hand pane via the small '+' icon that appears when you hover your mouse over an item in the left-hand pane (see Step 1, above). Once the right-hand pane is

populated (you can move tracks up and down the order), you need to click the small Save button at the lower right corner (Step 2) and then name the playlist via the input box that will appear at the top of the left-hand pane (step 3). Network lag can lead to seconds passing after each mouse click, making the process even more annoying, so be patient.

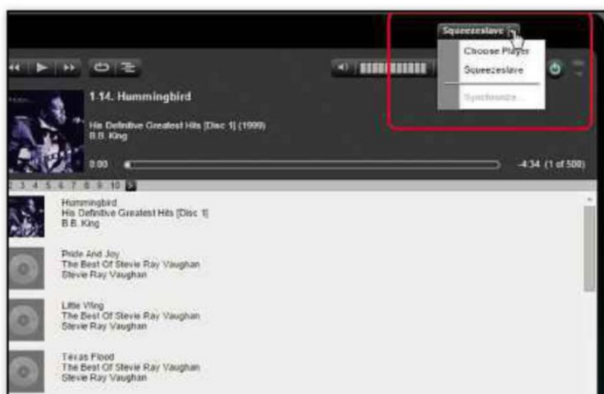
Thankfully you can add groups of tracks to playlists: if you browse by genre, album or artist in the left pane you'll see that each result has the '+' icon, so you can add all Blues tracks to a playlist with a single click, for example.

You may now have a Squeezebox server and music playlists, but you'll need a Squeezebox player to actually listen to music (you can't even listen to music via the Squeezebox web page, as it's just a remote control). Next month we'll show you how to make your Pi into a

Squeezebox player, but for now we'll use an iOS or Android device. Install Squeezecast (free, iOS) or SB Player (£1.88, Android) on your smartphone or tablet.

You'll need to enter the settings for your Squeezebox server. You can find the IP address and port by looking at the address of the Squeezebox web page; ours said '192.168.1.145:9002' so our server had an IP address of 192.168.1.145 and Squeezebox was using port 9002. The app should then find your Squeezebox server and load your playlists and tracks. The Squeezebox web page should also report that it's found a Squeezebox player in the drop-down menu toward the top-right of the page; in the case of iOS's Squeezecast, the device and app showed up as 'Squeezeslave'.

Using a mobile device is a useful way to test that the back-end of your setup is working. Next month we'll show you how to play your music via your Raspberry Pi.



↑ Check that a smart device has been recognised as an acceptable Squeezebox Player via this menu on the Squeezebox web page

## NEXT MONTH

### COMPLETE YOUR MULTIROOM AUDIO SYSTEM

We show you how to transform your Raspberry Pi into a Squeezebox Player that will link with the Squeezebox server you've just set up

# Recording voices and acoustic instruments

Choosing the right microphone and positioning it properly can make a huge difference to audio quality. **Ben Pitt** explores the possibilities



**MICROPHONES ARE EVERYWHERE**, from those in digital cameras, tablets, phones and laptops to dedicated models designed for audio production. There's no fundamental difference between them, and in many cases a cheap microphone is capable of high sound quality. However, there's more to a successful audio recording than the quality of the microphone itself. In this article we'll explore the entire process, reveal what equipment to use and explain how to get the most from it.

## MAKING WAVES

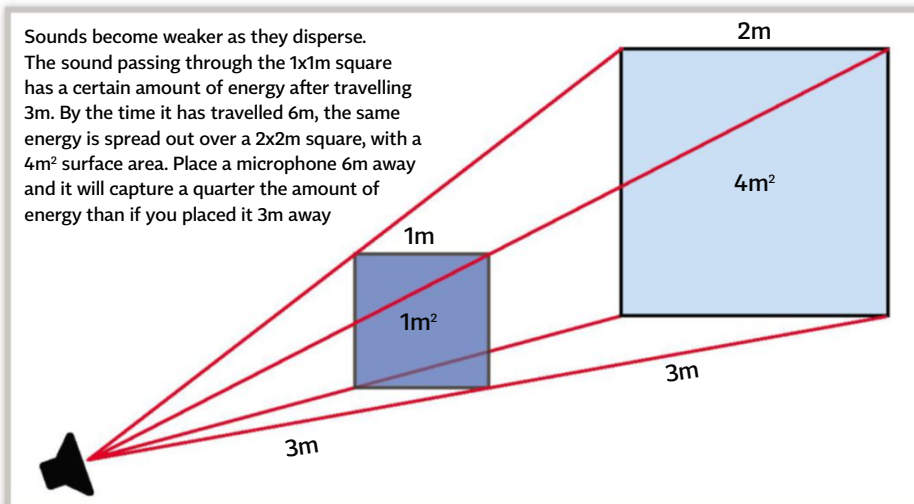
Sound is fluctuations in pressure, travelling as a wave. It's usually thought of as travelling through air, but sound can also travel through water, glass, walls – anything except a vacuum.

In some respects sound behaves like light. For example, with a source such as a person's voice, the sound energy decreases by a factor of four each time the distance travelled is doubled. This phenomenon is known as the inverse square law, and is demonstrated by the diagram below. If the maths is a turn-off, just remember that sound gets quieter very quickly the further you are from the source.

Sound also behaves like light in that it reflects off some surfaces and is absorbed by others. As a rule, hard surfaces such as walls, windows, floors and ceilings act like mirrors for sound, reflecting it back. Uneven surfaces such as the nooks and crannies in churches scatter the reflections in different directions, similar to light bouncing off a white wall.

Soft objects such as sofas, curtains and clothes absorb sound in the same way a dark object absorbs light. However, this absorption depends not just on the type of material but also its thickness. Lower frequencies will only be absorbed if the object is longer than the audio frequency's wavelength. In practice that means curtains will only absorb very high frequencies and have hardly any effect on lower frequencies. A sofa will absorb most

frequencies but bass notes below about 200Hz will pass straight through. This explains why a room with no soft furnishings, such as a bathroom, sounds more echoic than a bedroom. It also explains why you hear mostly bass notes when the neighbours have their hi-fi turned up loud. The wall reflects most of the sound back into the neighbour's room. Some sound penetrates the wall but the higher frequencies are absorbed, letting only the bass frequencies through.



## PICK-UP ARTIST

These concepts of sound radiating, reflecting and absorbing are crucial to controlling what a microphone picks up. Understanding how sound behaves means you can get more of the sound you want into the microphone, and less of the other stuff.

Recorded sounds can be divided into three types: direct sound, reflected sound and other sounds. Direct sound goes straight from the source into the microphone, and its volume follows the inverse square law as it travels.

The reflected sound will typically bounce around the room a few dozen times before being absorbed. These reflections are known as reverberation, and they're what give cathedrals, concert halls and living rooms their distinctive acoustic signatures. Natural



reverberation can be desirable, such as when recording a choir or orchestra in a concert venue with great acoustics. However, in most cases it's best to minimise the amount of reverberation picked up by the microphone. If you want reverb as a creative effect, you can always add it later in controlled amounts in your music- or video-production software.

Because the reflections bounce around the room many times, the reverberation is roughly the same volume no matter where you place the microphone. That means you can't reduce the volume of the reverberation easily. However, you can change the volume of the direct sound by placing the microphone as close as possible to the source. That way, you capture more direct sound relative to the reflected sound, and in effect lower the volume of the reflections.

This also applies to other sounds you probably want to avoid: traffic, washing machines, fridges, other people talking and so on. Get as close as possible to the source of what you're trying to record and the relative volume of all other sounds will be reduced.

### MICROPHONE PLACEMENT

The above might seem obvious, but there are times when the technology doesn't make it easy. For example, when shooting a video of someone talking, you may want to place the camera two metres away to frame the subject in the lens. However, this can make the speech unintelligible, not because it's too quiet to record but because you end up with lots of reverberation and background noise. The direct sound becomes swamped with reflections that create a muddy sound that's hard to understand.

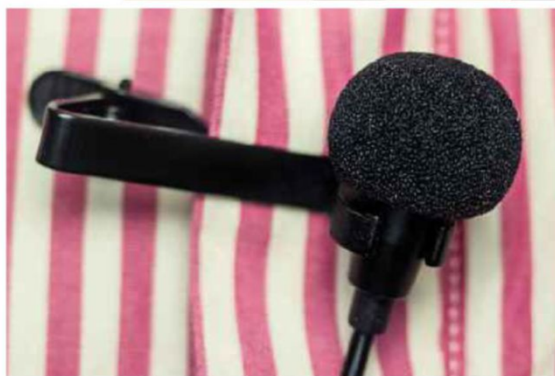
The solution is to abandon the microphone on the camera and use an external microphone. You'll get the cleanest recording by placing it close to the person's mouth, but anything in a 50cm vicinity should work pretty well.

Bear this in mind when using a laptop, tablet or phone to make video calls, or when using a speakerphone mode in noisy environments such as a car. A headset or hands-free kit might not make much difference to what you hear, but it can make a huge difference for the person on the other end of the call.

Microphone placement gets a bit trickier when recording acoustic instruments. The principle of moving the mic closer to reduce the volume of reflected and other sounds still applies. However, many instruments radiate sound in complex ways, so even the direct sound can vary dramatically depending on where you place the microphone.

Brass instruments are easiest to record because – like voices – they're essentially a point source of sound. The sound comes straight out of the bell of the instrument, so placing the microphone somewhere in that

Studio microphones designed for vocals often need an elastic cradle and a mesh pop shield to avoid picking up rumbles and pops



▲ A lavalier microphone clips discreetly on to clothing and picks up speech more clearly than a microphone mounted on a camera

vicinity is all it takes. Woodwind instruments such as clarinets, flutes and oboes aren't so easy, as the sound comes out of the various holes along their length, depending on which note is played. Saxophones count as woodwind rather than brass because they're based on the same acoustic principles. For woodwind instruments, placing a microphone too close to a particular hole will cause some notes to be much louder than others. Placing it about 50cm away should give an even balance.

For stringed instruments such as violins, cellos and acoustic guitars, most of the sound comes from the resonant chamber, radiating from the circular or f-shaped holes and also from the body of the instrument. However, pointing a microphone at different parts of

the instrument and from different angles can produce a wide variety of tones. As a general rule, facing the main body of the instrument will produce the fullest tone, but it's worth experimenting to see what sounds best.

For acoustic guitars, using two mics in different positions – perhaps either side of the strumming position – will produce a pleasing stereo effect if you pan them left and right in the mix. In fact, this is true for most instruments, particularly larger ones where there's room to place microphones in different positions around the instrument. A stereo mic technique is standard practice for acoustic pianos, placed near to the strings for a bright, punchy pop piano sound or further away for a more classical tone.

Electric guitars and basses are unusual in that they don't make much sound at all by themselves and require an amp to produce sound. The easiest way of doing this is to plug a guitar or bass into the computer and use an amp simulator effect. The quality of these effects is often excellent, and it's easy to tailor the tone to your exact requirements. If you own a decent guitar amp, you can record it by putting a microphone in front of it. Positioning it an inch away from the centre of the speaker cone does the job. This has the added benefit of capturing the interactions between the guitar and amp – chiming



↑ Focusrite's Scarlett 2i2 is a USB audio interface that provides two XLR microphone inputs with phantom power

resonance, extra sustain and perhaps even wailing feedback if that's what you're after.

A drum kit is the trickiest instrument to record because it's very big, and each drum and cymbal faces in a different direction. Standard practice is to have separate microphones for each drum, and often two for the snare, with one underneath. The hi-hat gets its own microphone, while two overhead microphones are used to capture the other cymbals. In fact, the overheads pick up the entire kit fairly well. If you need to keep things simple, you can achieve a lot with two overheads and a kick drum microphone. You'll lose the versatility of being able to process each drum separately, but the resulting sound is lively and natural sounding.

For other instruments, trust your intuition. There's lots of received wisdom and standard practice, but ultimately anything goes if it sounds right. Remember to listen critically to the microphone signal before committing to it, and be prepared to move the microphone a few times in order to get the sound right. You can also learn a lot simply by moving your ears around the instrument as it plays.

## MOUNTING TROUBLE

Once you know where you want your microphone or microphones to be, the next challenge is keeping them there. Headsets are ideal for capturing speech because the microphone is positioned an inch or two from the mouth, and it stays there no matter how much the singer or speaker moves around.

A headset mic isn't always the right look, though, in which case a lavalier microphone might be more appropriate. This mic clips on to clothing about 20cm from the mouth. Unlike light rays, sound has no problem going round corners, so there's no need to position the microphone in the direct firing range of the person's mouth.

In fact, it's often best to avoid positioning it directly in front of the mouth. Certain consonants known as plosives – 'P' and 'B' – create a small blast of air that can distort the microphone if they score a direct hit. For both headset and lavalier microphones, positioning them slightly off axis will avoid picking up these plosives.

When using microphones for public speaking or music performances through a

PA system, another challenge presents itself: feedback. This is when the microphone signal is played through loudspeakers, which is then picked up by the microphone again. Cross a certain volume threshold and this quickly escalates into ear-piercing feedback. Again, the solution is to get the microphone as close as possible to the person's mouth to capture more direct sound, reducing the level of the feedback signal. A lavalier microphone can work for a modest amount of amplification, but a headset microphone will let you turn the voice up louder in the speakers.

Most singers feel more comfortable using a larger microphone, either handheld or on a mic stand. These work perfectly well for public speaking, too. Handheld microphones that are designed for vocal use have an integrated pop shield – a layer of foam that prevents plosive blasts of air from distorting the microphone. In many cases it's located under a wire mesh basket.

The best microphones for studio use tend to be designed only for use with a microphone stand. Using them handheld would result in lots of bumps and scuffles being picked up. Some even require – and hopefully come with – an elastic suspension mount called a cradle, which prevents movement passing up the microphone stand and transmitting rumbling noises into the microphone. These microphones often lack any kind of pop shield, but these are available separately for about £15 and clip on to the same mic stand.

Mic stands cost from around £30 each, but this can mount up if you need to record a drum kit

→ If your video camera doesn't have a mic input, or if you want to record on location using XLR microphones, the Tascam DR-40 standalone recorder solves both problems

or large ensemble. There are various ways to reduce the cost, though. A desktop stand for about £10 may be sufficient in some circumstances. A stereo crossbar lets you attach two microphones to a single stand.

Some microphones clip directly on to instruments. That would be too

close for many types of instrument, but it works well for snare and tom tom drums, and also for brass instruments.

Some video microphones are designed to sit on cameras' accessory shoes. They often improve on the quality of the microphone itself, and may help to avoid picking up mechanical noises from the lens's zoom, autofocus and aperture motors. Some also include substantial wind shields, so the soundtrack won't be ruined by wind blowing on the microphone.

However, using a camera-mounted microphone won't affect the balance of direct, reflected and other sounds. If you're recording speech for video projects, you might get better results from a £20 lavalier than a £200 camera-mounted microphone.

## NATURAL RESPONSE

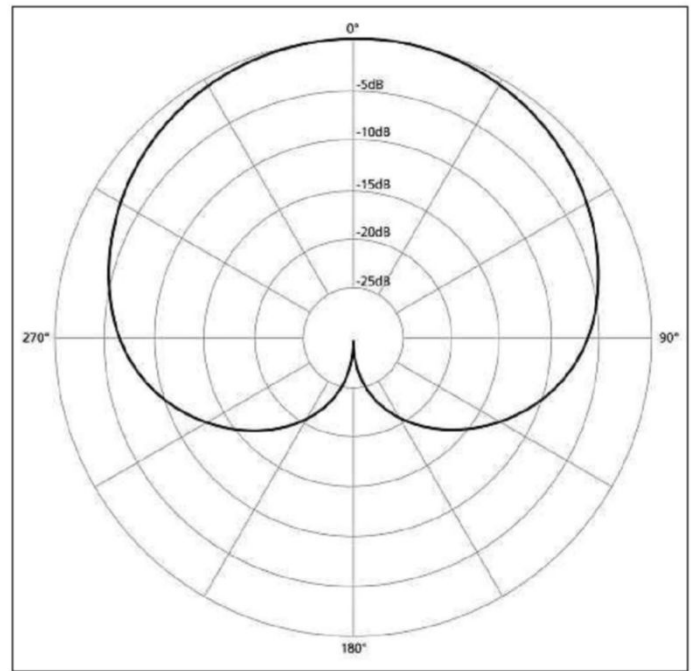
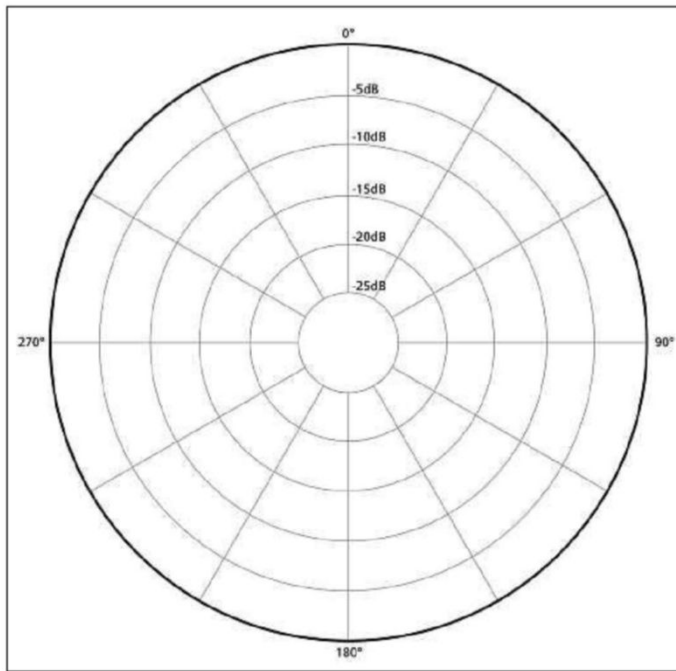
Microphones vary in how responsive they are in different directions. An omnidirectional microphone picks up sounds in all directions, which can be useful in some situations. In most cases you're better off with a cardioid microphone, which is more sensitive in one direction than the others. The name comes from the shape of the response pattern, called a polar response, which for a cardioid mic resembles a heart. Most microphones are cardioid, but bear in mind that the most sensitive side isn't always the end of the mic. In some cases it's the side, with the correct side denoted by a label or logo.

There are a few other polar responses, such as figure-of-eight and hyper-cardioid, but omni and cardioid are by far the most common.

Most microphones are designed to give a flat frequency response, although cheaper ones often struggle to achieve this throughout the 20-20,000Hz hearing range. Some microphones are deliberately designed to accentuate certain frequencies. A boost at around 1-2kHz adds some extra presence and clarity, particularly to vocals, and many microphones have this built in. Mics that are designed for kick drums often have a bass boost. However, it's not hard to achieve the same result







▲ A microphone's polar response shows how it responds to audio coming from different directions. Omnidirectional (left) and cardioid (right) are the most common

using EQ controls in recording software, but having it built into the microphone can make the effect sound more natural.

### WIRING UP

It's all well and good having a microphone with the right mount, polar response and frequency response, but it's no use if you can't plug it in. The most common connector for consumer microphones is a minijack – the same that's used for headphones. Lots of digital cameras, laptops, tablets and phones include this input. For tablets and phones, the socket is often shared with the headphone out, so you'll need the correct type of cable to connect them.

There's nothing particularly wrong with minijacks, but they're not the most robust connection type. Some decent microphones have minijack outputs, but the microphone inputs built into consumer devices tend to be fairly basic, and might suffer from noise or a general lack of clarity. They're fine for most purposes but probably won't make the grade if you want the highest audiophile standards.

When a microphone is deemed to be professional quality, it's usually because it has an XLR output. XLR connections are physically stronger and less susceptible to noise, but the main advantage of going for XLR equipment is simply that this is what the higher-quality microphones tend to use. You'll need XLR inputs too, of course. For video production, that probably means recording to an external recorder (see below). There are lots of USB audio interfaces designed for music production that include XLR inputs. Check out the ranges from Steinberg, Focusrite, Alesis, M-Audio and others, available at specialist music stores such as Digital Village ([www.dv247.com](http://www.dv247.com)).

These interfaces vary enormously in features and price. They also vary in sound quality, with the best ones using superior

microphone preamps to boost the level before analogue-to-digital conversion, and superior converters too. However, the quality of components used in these devices generally varies from good to excellent.

For stereo recordings with two XLR mics, £100 will buy a decent USB audio interface. To record four or eight simultaneous microphones, you'll need to spend more. Either way, make sure the XLR inputs include phantom power. This sends a DC current back up the cable to power the microphone, and is required by many studio microphones.

**It's all well and good having a microphone with the right mount, polar response and frequency response, but it's no use if you can't plug it in**

Some microphones have USB connections, which means the preamp and analogue-to-digital converter is built in. These can be convenient for recording speech directly to a laptop, but they can be a pain when recording music because you have to use a different audio device for the computer's audio output. Running two audio devices in parallel can lead to synchronisation problems.

If your video camera doesn't include a microphone input, you'll have to record with an external recorder. It can be a bit of a rigmarole remembering to start and stop both recording devices, and then there's the matter of syncing them up in video-editing software. That's not as tricky as it might seem, especially if you record a clear


audio cue, such as a handclap at the start, to help you line up the video and audio by eye on the timeline.

Standalone digital audio recorders are available from around £100 from the likes of Olympus, Tascam and Zoom. They have integrated, high-quality stereo microphones, plus minijack inputs for connecting external mics. Some also include XLR inputs, and some can record simultaneously from both their internal microphones and XLR inputs.

If you need a low-cost alternative, try using a phone or tablet, either with a cheap minijack microphone or even with its built-in microphone. It's better to have a basic microphone in the right place than a great microphone that's too far away. Be sure to use a recording app that records high-quality audio; some apps use heavy compression to keep file sizes down.

### PRESS THE RED BUTTON

We haven't recommended any specific microphones in this article. Our own collection includes models by Rode, Audio Technica, AKG, Sennheiser and Shure, but there are lots of other excellent brands available. Seeking advice and buying from a specialist music technology store should ensure you get something suitable.

There are lots of other factors to creating a high-quality audio recording, from managing levels and compiling multiple takes to applying effects. If you get it right at the start of the chain, you can set yourself up for a polished end result. 

### NEXT MONTH

#### FREE LIGHTROOM ALTERNATIVES

We investigate the free rivals to Adobe's all-conquering workflow and photo-processing software

# Advanced photo editing with Photoshop Mix

Adobe Photoshop Mix is an iOS app that combines simple filters with some unusual creative and corrective features. **Ben Pitt** reveals its secrets



**THE SHIFT FROM** desktop software to mobile apps has caught some publishers on the hop, but Adobe has embraced the change. Photoshop Mix is available for free for the iPad, iPhone and iPod Touch. It's not as feature-packed as Photoshop Touch (£7.99 for the iPad, £3.99 for the iPhone) but there's a surprising amount it can do even with its small collection of features.

## HEAD IN THE CLOUD

Creative Cloud is Adobe's subscription service for its desktop applications, but it's also the name of its cloud storage service. Customers on paid subscriptions get 20GB of online storage, but it costs nothing to sign up for an Adobe ID and receive 2GB of free storage, which you have to do to use Photoshop Mix.

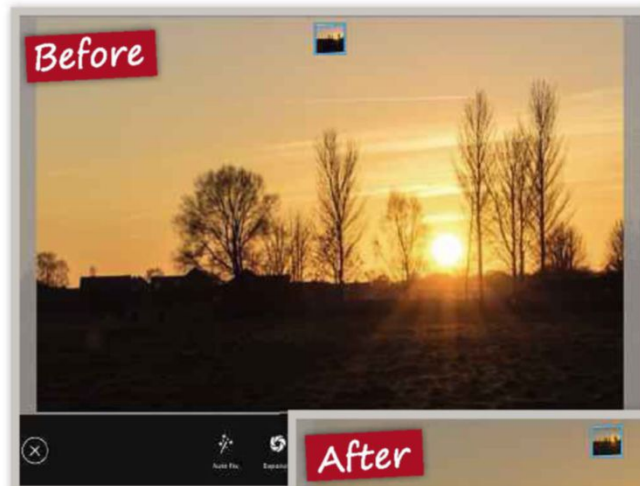
The app can transfer images to and from the iOS device's Camera Roll, but saving to Creative Cloud has various advantages. It provides an offline backup, and makes it easy to transfer files to a desktop computer. It also means projects can be saved in PSD format, retaining separate layers and masks for later editing. Transfers work both ways too, so files can be uploaded from a desktop computer to the cloud and downloaded to Photoshop Mix.

With the app installed, tap the + button to load an image from the available sources: the iOS device's local storage, Creative Cloud, Lightroom (via Creative Cloud), Facebook or Dropbox. Existing projects can be saved to Creative Cloud as a PSD file using the Save to Photoshop option. Tapping the Creative Cloud icon below a file in the browser backs up that project, complete with settings.

## SHAPING UP

The first task for most photo-editing jobs is to crop and straighten the image. As we'll explain **below**, there are some situations where you might want to hold off doing this until later, but we'll cover it now because it's so **easy**.

In fact, it's arguably a little too **easy**. If no editing tool is selected, dragging the canvas to move, pinching to zoom or twisting to rotate performs an edit rather than just changing your view of the canvas. **Thankfully**, this and many other edits are non-destructive, so cropped pixels are merely hidden rather than removed. **However**, if you want to overlay two copies of the same image (for reasons we'll explain **below**) it's best not to crop just yet.



◀ Lowering the contrast and boosting the clarity controls brings out details in shadows and highlights while still maintaining punchy contrast

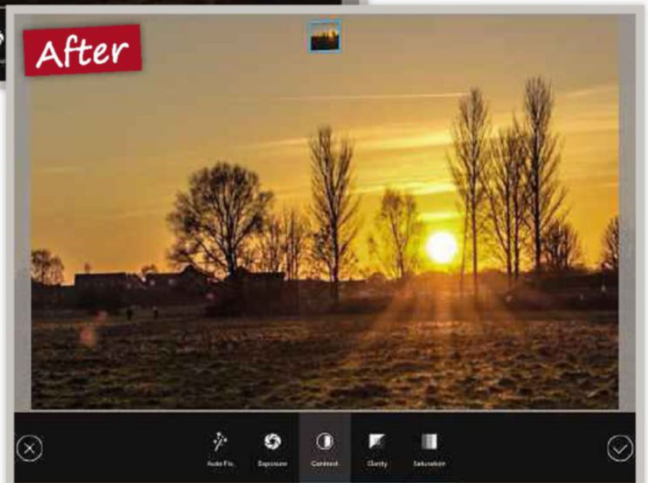
Moving, resizing and rotating when no tool is selected only adjusts the one layer. To perform a conventional crop that affects both layers, tap the Crop button. Edits can still be made by dragging the canvas **itself**, but here you can also drag corners and edges to adjust the size and shape of the canvas. Various preset aspect ratios are available via the thumbnails at the bottom.

## COLOUR CORRECTION

Tapping the Adjust button reveals Photoshop Mix's colour-correction controls. The Auto Fix button calibrates colours **automatically**, but it's easy to fine-tune these settings or process colours **manually**. Adjustments are made by selecting a control and swiping left and right.

Exposure, Contrast and Saturation need no explanation, but the Clarity control is more unusual. This boosts the contrast compared to nearby pixels, placing the effect somewhere between contrast and sharpening. It's useful for bringing out details, but without the risk of obliterating shadows and highlights as the Contrast control is prone to doing. Boosting the clarity can make faces look a bit **craggy**, but it often works a treat for landscapes.

**Frustratingly**, Photoshop Mix lacks a gamma control for adjusting the brightness of mid-tones. **However**, reducing the contrast



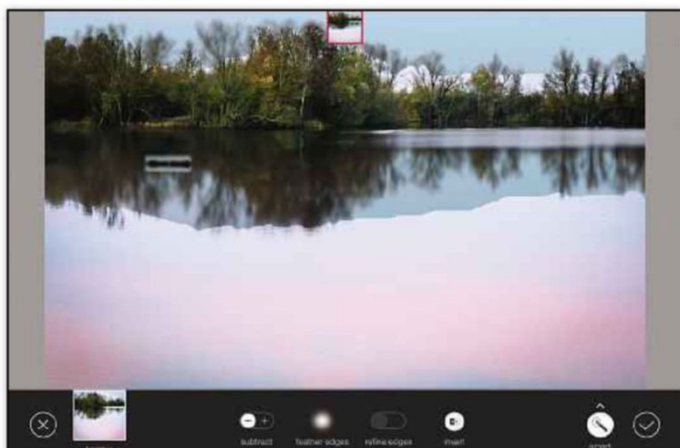
and boosting the clarity does an excellent job of revealing details that are getting lost in the darkest and brightest parts of the image.

## GET THE LOOKS

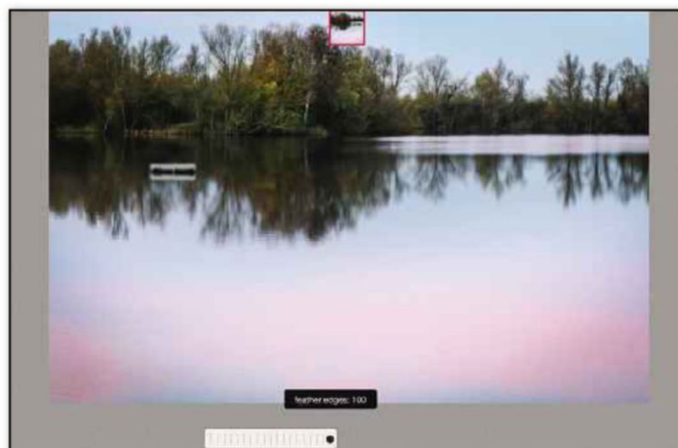
Photoshop Mix's Looks are one-click creative effects along the lines of Instagram filters. Some are quite dramatic, such as the high-contrast, grainy colours of Twilight or the washed-out sepia tones of Vintage. Others, such as Natural, Brighten and Landscape, are designed to flatter colours without making images look obviously processed.

These filters become more interesting when they're applied to a limited area of the frame, and this is something at which Photoshop Mix excels. Simply swipe a finger across the image while auditioning filters, and the selected filter will only be applied to the area you've selected. Doing so will also reveal controls for modifying the selected area.

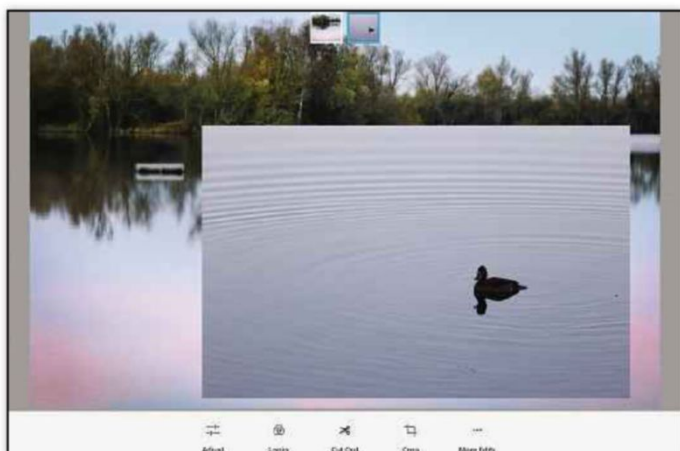




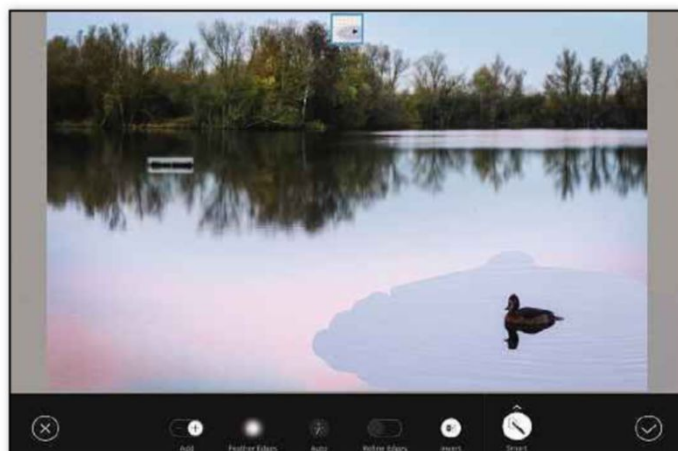
↑ Applying a Brighten filter to the foreground and trees helps those areas stand out...



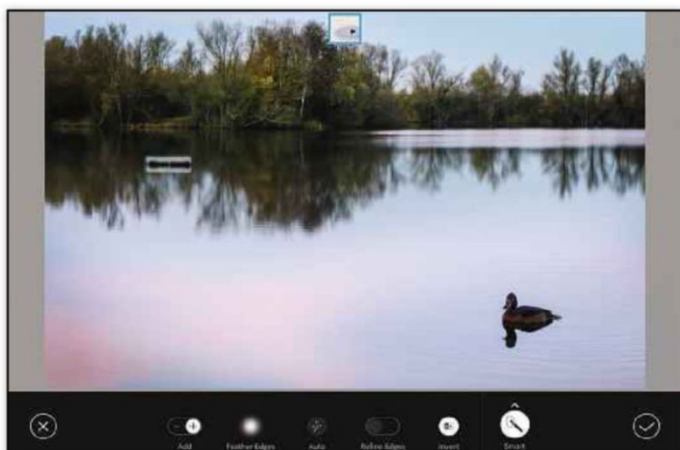
↑ ...and feathering the edges of those areas blends the filtered and other parts of the image



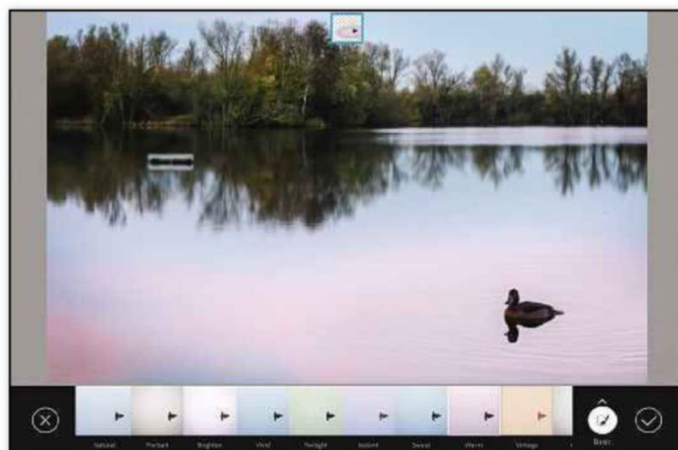
↑ In comes our duck to add some interest to the foreground



↑ We've adjusted colours and cut it out, including the ripples that surround it...



↑ ...and then feathered this selection too



↑ Finally, a Warm filter is applied to the ripples to match the reflected clouds. The duck has been masked out of this filter so it doesn't become pink too

There's a choice of Basic or Smart area selection; the latter automatically follows the contours of shapes in an image. This usually gives the best results, but sometimes Smart selection can misinterpret shapes in a photo. In that case, switch to Basic mode, adjust the brush size, zoom in with a two-finger push and define the area you want **manually**. Switching between Add and Subtract modes is useful for fine-tuning a selection.

Enabling Refine Edges softens the edges of the selection to avoid harsh borders, but does so in an intelligent way so crisp edges remain

sharp and softer or complex edges such as hair and foliage are handled appropriately. It's nearly always worth having this enabled. Feather Edges applies a blanket softening to the edges of the selection, and can be useful for applying subtle colour tweaks.

Finally, the Invert button flips the selection. This is useful for when it's quicker to define the areas of the image you don't want to be processed rather than the areas you do. For example, a common trick is to have the main subject in full colour and convert the background to black and white. You achieve

this by selecting the Portrait filter, selecting the main subject and then tapping Invert.

Filters applied in the Looks section will interact with any colour correction applied in the Adjust section, so you may find you need to return to the Adjust controls. This is where Photoshop Mix's non-destructive approach comes into its own. Because neither set of effects has been applied permanently to the image, you can adjust or remove them at any time. You can also fine-tune settings without having to apply the filters over and over again, which would degrade image quality.

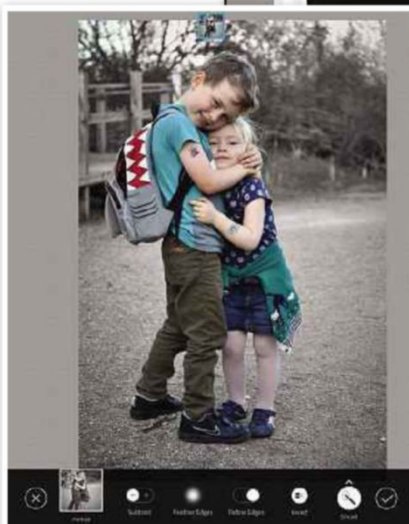
## BE SELECTIVE

Photoshop Mix supports two layers for combining two different photos. It also means you can import two copies of the same photo and process each one separately. Using the Cut Out tool to remove parts of the upper layer, this means you can apply two sets of colour correction settings and two independent Looks to different parts of the image.

Tap the square with a + symbol at the top of the screen to load an image into the upper layer. This is the job we referred to earlier that is best to do before cropping the image, or else the two layers won't align correctly. If for any reason you want to swap the order of layers – perhaps to see what's on the lower one momentarily – just drag one layer over the other.

The Cut Out tool is the same as the selection tools built into the Looks filters, except for an additional Auto button. Tapping this prompts the app to hazard a guess at what the main subject of the photo is. In some cases this might provide a useful shortcut, but if there are lots of errors it might be easier to tap Undo and make the selection manually with the Smart or Basic brush. Cut Out is yet another non-destructive tool, so the pixels you can't see are hidden rather than deleted. That means you can return to this tool at any time to adjust the selection.

The Cut Out tool can also be used to combine two different photos, of course. Achieving photorealistic results isn't easy, as it depends on the lighting and perspective of the two images being compatible with each other. We managed to get away with it with our duck dropped into a lake (see opposite) because both photos were taken in overcast conditions and there wasn't much in the way



↑ Applying the Portrait Looks filter to the background helps subjects stand out

the filter applied only to the water did the job.

## SERVER-POWERED EDITS

Photoshop Mix's other tools, located under the More Edits button, are available only when the iOS device is online. They involve uploading image data to the cloud for analysis on Adobe's servers. It's an odd approach, but it does the job without too much delay. If the features don't work, double-check that you're successfully logged in with an Adobe ID account. Initially we found that the app hung at zero per cent progress, but re-entering our Adobe ID username and password resolved the problem.

The Upright tool is similar to the one in Adobe Lightroom. It identifies straight lines in photos and skews the image so those lines are parallel to the edges of the photo. This often improves the appearance of buildings, removing the sense of perspective that makes them appear to taper towards the top. It can help improve the composition of all sorts of other photos, too.

Shake Reduction is a feature that was recently introduced to Photoshop CC, so it's a bit of a surprise to find

it in a free app. Essentially this is a form of digital sharpening, but it analyses images to try to identify the exact shape by which pixels are blurred due to camera shake. The app offers three processing results from which to choose. In our tests none of them looked particularly convincing, but it's an interesting tool to experiment with.

Content-Aware Fill is probably the most useful of the three online tools. If there's something – or someone – you'd prefer not to be in a photo, select this tool, paint over the unwanted subjects and tap Fill. The app then clones from other parts of the image to cover up the offending item. It works best for backgrounds with a random texture such as grass and trees. Regular structures such as buildings can make the cloned area much easier to spot. There's a lot of intelligence built into this tool, though, and the results are often highly convincing. We like photos to have a strong, simple composition, and getting rid of minor distractions can go a long way towards achieving this.

## MIXED RESULTS?

It's early days for Photoshop Mix, and there are plenty more things we'd like to see included, such as white balance and gamma adjustment, support for more than two layers, and possibly the ability to match colours in different layers automatically. It's also frustrating that the Undo function is only available while making adjustments to a particular tool, and when moving from one tool to another. It's an excellent start for this app, however, and we're looking forward to seeing how it develops.

## NEXT MONTH

### MOBILE ROCK

Turn your iOS device into a virtual guitar amp with our guide to hardware and apps



↑ A combination of Adjust and Looks settings on two layers has let us apply different settings to the foreground, horizon, boat and sails



# Zygote

Festival organisers should keep mum about Mum, advises **Zygote**, while smartphone users need to stop putting their backs into it

## MUM'S THE WORD

The promoters of Manchester's Parklife music festival should have had a premonition of a PR catastrophe. There was someone called Lazarus on the bill. The organisers thought it would be fun to send all 70,000 festival-goers a spoof text message from their 'Mum', advising them to get after-party tickets and be sure to make it home afterwards in time for Mum's special breakfast.

When Parklife received a mass of complaints, they made a series of crass jokes about mums on Twitter, but the situation didn't seem so funny to the recipients whose mums, like Lazarus, appeared to have risen from the dead. One music-lover, whose mother had only just died, suffered considerable distress when the message from Mum flashed up on her mobile. And many others whose mothers were estranged, ill or simply unknown were none too pleased either. And neither is the Information Commissioner's Office, which has fined Parklife Manchester a pound for every spam text message sent.

## FED UP

It's no secret the FBI would love to access every scrap of private data on the planet, including all encrypted files resident on cloud networks, computers, tablets and smartphones. That's why the Feds have just cited an archaic US law called the All Writs Act to try to gain access to scrambled data on a privately owned Apple iPhone 5s. Uncle Sam's spooks demanded Apple provide "all reasonable technical assistance" to unscramble suspect file content, under a law drafted by George Washington in 1789.

This appears to be a creative legal tactic, but Zygote can report that Apple is mightier than the Founding Fathers of the American constitution, arguing that it cannot help the FBI because its iPhone system allows

users the right to passcode-protect their phones, and such protection is nothing whatsoever to do with them. Whatever next? A war of independence?

## OZ PRAY

When Australia's games retailers banned Grand Theft Auto V, fans of the title hit back. The all-time best-selling game has netted over \$2bn, but 50,000 people signed a petition demanding it be withdrawn from sale because it "encourages players to murder women for entertainment".

All branches of the Kmart and Target stores promptly complied, but now another petition has been received demanding a book should also be taken out of circulation, which instructs readers to "kill women by stoning them to death, burning them alive, cutting off their hands and killing their children".

Zygote awaits an Australian thunderclap if the offending book is removed from the shelves. It is, of course, The Holy Bible.

## HEADS UP

Spine surgeons in New York have identified a dangerous new condition that could lead to millions of people literally losing their heads. The cause of the terrible ailment is none other than the ubiquitous mobile phone. Dr Kenneth Hansraj calls it Telepressure, and has published a dire warning in the prestigious

*Journal of Occupational Health Psychology*. It goes like this:

In pre-mobile days, when humans walked tall and looked the world in the eye, no more than 5kg of forward pressure was exerted on the neck. But as the head tilts forward into the habitual slouch of the cellphone-fondler, this force increases alarmingly. People used to spend an hour a day hunched over their screens, but this unnatural stance has increased massively, and according to the good doctor it can now be up to 1,400 hours of excess spinal stress a year. The incline of a phone-enslaved head is anything between 45° and 60°, and the weight on the spine soars to as much as 25kg, leading to back pain and insomnia.

The remedy is obvious, but Zygote knows that sufferers won't take a blind bit of notice. Addiction dictates that sensible advice is ignored.

## X-FACTOR

Ilja van Sprundel is the hilariously titled Director of Penetration Testing at IOActive in Seattle, but what he has just discovered isn't funny at all. There is a security bug in the open-source system used by millions of computers that opens a back-door to unused memory, allowing malicious data to be fed into the system. A standard X Server plugged into a Unix desktop can be hacked at the touch of a button.

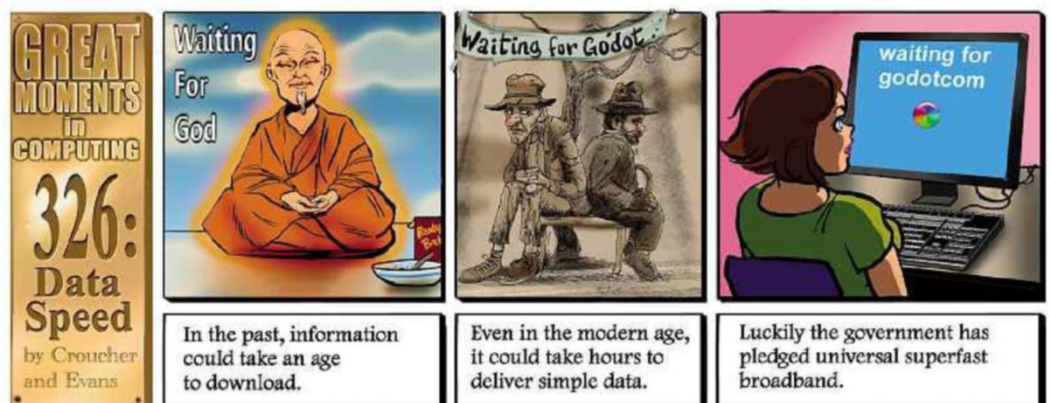
What is shocking about the discovery is not how serious the problem is, but how long the buggy software has been around. The code extensions became free-to-use open source in 1999, the code itself was introduced in 1991, and the original protocol requests were authored in 1987. That's 28 years for hackers to go quietly about their business without any alarm bells going off.

## PRIZE CHUMPS

The 2014 Wall of Shame revealed no surprises when the league table of UK data security breaches was published. It turns out the grand total of zero pounds was levied in fines due to confidential data exposed by technical failure, whereas human error resulted in fines of over five million quid.

Taking the Gold Medal for data cock-ups, healthcare organisations top the poll with the highest number of data breaches, doubling year on year. The Silver and Bronze awards go to banking and the insurance industry, both managing to triple their tally of security incompetence.

Cases against telecoms companies were only up 150 per cent, but at least they proved yet again that it doesn't matter how much money you throw at security and encryption systems, there's nothing like good old-fashioned human idiocy to expose your customers to the risk of data scams. ☹



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